

PHOTO-ENGRAVING
PHOTO-LITHO
AND
COLLOTYPE

W. T. WILKINSON

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PHOTO=LITHO

AND

COLLOTYPE,

A

PRACTICAL MANUAL

BY

W. T. WILKINSON.

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PREFACE.

THIS book is neither a translation, nor a *pot pourri* of crude ideas, mixed up indiscriminately more with an aim to mystification, than of giving practical information. Every method and formula, herein given, is the result of years of careful practice and study, and is used exactly as printed by the author in his every day work.

Methods and formulæ however, are comparatively useless, except suitable apparatus and appliances be provided.

The elements of success are three, *viz.*, suitable apparatus, careful practice, and reliable formulæ. The student must provide the first two, the third being provided herein by

Yours Faithfully,

W. T. WILKINSON.

PART I.

PHOTOGRAPHIC MANIPULATIONS, &c.





PHOTO-ENGRAVING ON ZINC, IN LINE, AND IN HALF TONE.

CHAPTER I.

THE foundation of success in any photo-mechanical process, is a good and suitable negative, and this can only be produced with good apparatus, and in well arranged work-rooms, therefore the first care of the student must be to provide these necessities before beginning to work ; the common plan of starting with improvised tools being sure to end in failure.

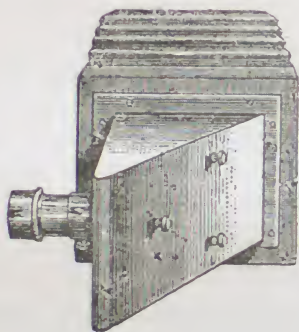
A good lens is indispensable, and if purchased from a good English maker is sure to be satisfactory.

The best type of lens for this work, is either a rapid rectilinear, or a triplet. The triplet lenses are obsolete, and can only be obtained second hand, but when such lenses bear the name of either Dallmeyer or Ross, they may be purchased with confidence, as no better instruments can be obtained.

The rapid rectilinear is a doublet, and is sold under various names given by opticians to cheap foreign lenses, and which beginners should have tried by an expert before purchase, as the proportion of good lenses, suitable for copying, is extremely small.

Lenses bearing the names of Dallmeyer, Swift, Wray, or Beck, or the Rapid Symmetricals of Ross, are always reliable, and guaranteed; wide angle rectilinears may be used for copying, but those below 12×10 , are of such short focus, that the camera is apt to obstruct the light, and cause the picture to be unevenly illuminated.

The single landscape lenses, and portrait or petzval lenses will distort the lines, and must not be used.



In ordinary photography, the lens is fitted direct in the front of the camera, but, for making negatives for photo-zincography, a mirror is placed behind the lens, which reflects the image upon the sensitive plate, this mirror is a piece of perfectly flat glass, coated with a film of pure silver, highly polished. This mirror is mounted in a box at an angle of 45 degrees, the base of the box being made square, so that the lens can be pointed either side-ways, or towards the floor, this last position being very handy when copying out of a book, or in a room not well illuminated.

The size of the mirror will depend upon the diameter of the lens, for a lens the diameter of which is two inches, the mirror must be $5\frac{1}{2} \times 2\frac{1}{2}$ inches, if 3 inches, $7 + 4$ inches ; the cost of these mirrors is one shilling per square inch, silvered ready for use, to this must be added the cost of the box which is from 15 to 30 shillings.

Great care must be taken of the mirror, the silver surface being easily tarnished, remove it from the box each evening, warm slightly, and wrap up in a piece of velvet also warmed, so as to drive away the damp, warm slightly before using also, full directions as to the general management and re-silvering of the mirror will be found in the Appendix.

The camera must be strong and rigid, the bellows extending to a sufficient length to allow a picture being copied same size, *i. e.*, the camera must extend a little over twice the focal length of the lens used to cover the largest plate, a camera for plates 24 by 18 must extend 6ft. 6ins., for plates 15 by 12, 4 feet ; and for plates $8\frac{1}{2}$ by $6\frac{1}{2}$, 30 inches.

Cameras purchased for copying should not be fitted with a swing back, it being totally unnecessary, but small cameras, intended for occasional out-door work, will require a swing back.

The dark slide must be well made, and quite light tight, for indoor work the single slide being preferable, in fact for the wet process it is most imperative.

The stand for the copying camera, must be strong and rigid, fitted with castors running upon rails fixed on the floor at right angles to the easel upon which the drawing or plan is fixed for copying. The stand must be quite level, as it is

absolutely necessary that the camera, and original be perfectly parallel, small cameras should be fixed upon the stand by a screw, or else in putting in the dark slide there is a danger of moving it, do not try to use a tripod stand for copying.

The easel is placed so as to be perfectly parallel with the camera, and painted a dead black, with two white lines upon it, intersecting in the centre, these lines being divided, and marked into inches and half inches from the centre, the centre of the board to exactly correspond with the centre of focussing screen. The easel must be placed in such a position that the whole of it is evenly illuminated from above, as well as from the side; a good size for the windows, lighting the studio being 8 feet wide. Where the formation of the room is such that no side light can be provided, a skylight 8 to 13 feet square, will answer admirably.

The floor of studio must be firm, as any vibration during exposure of plate in the camera will be fatal.

The dark room in which the sensitive plate is manipulated, will require great care in its preparation, as, whilst not dark in the visual sense, it must be in a chemical sense, the light admitted into it being filtered through a medium that deprives it of its chemical qualities; for wet collodion or the slow dry plates used for photo-zincography, the window of dark room may be covered with three thicknesses of golden fabric, a yellow calico sold for the purpose. This fabric must be fixed over the window in such a manner as to quite prevent any white light obtaining access to the room.

In front of the window a sink with waste pipe must be fixed, this sink should be about 30 by 24. A good supply of water is indispensable, the tap being placed at the side,

an india rubber tube being attached thereto, carried to the ceiling from which it is suspended, the other end of tube terminating in a rose and reaching to about six inches above the sink. The negative when being washed is placed upon a small stool three inches high standing in the sink. Provide as much bench and shelf room as possible, so as to keep the solutions from being splashed into one another.

The dark room must be kept entirely for the process of negative making, as the after processes of printing on zinc, and etching, cause so much dust, and deleterious fumes, as to speedily derange the chemicals used.

For successful work, it is imperative that the work rooms be kept at an even temperature all the year round, a good average being 60 degrees. If cold and damp, it is almost impossible to get good results. The dark, and works rooms must be provided with large clean towels, that the hands can be kept clean, and finally these rooms must be kept perfecting clean, as nothing will sooner cause failure than dirty and dusty workrooms.

CHAPTER II.

Wet Collodion Process, Preparation of the Chemicals.

NEGATIVES for printing on zinc may be made by the wet collodion, or the dry gelatine method ; for regular every day work the wet collodion process will be found the cheapest, the dry process being best when only an occasional negative is required ; as to quality, when ordinary care and

judgment are exercised, and the proper dry plates are used, there is no difference.

In the dry process, the plates are purchased ready for use. The various manipulations necessary to produce a negative upon a dry plate will be described in a subsequent chapter; this being devoted to the preparation of the chemicals for working the wet collodion process.

THE COLLODION.

Methylated Spirits of Wine (pure)	30 ounces.
Methylated Ether 720 ...	... 40 ounces.
Schering's Cellodine ...	... 1½ cakes.

Cut the cellodine into thin strips, or, if it be hard, break it up in a clean mortar, soak in the ether until soft, then add the spirits of wine; when dissolved, this forms the collodion.

THE IODIZER is composed of

Bromide of Zinc ...	... 150 grains.
Iodide of Zinc ...	... 350 grains.
Methylated Spirits of Wine	10 ounces.

When the salts are dissolved, filter, and add to the collodion.

The filtering is best done by placing a pledget of cotton wool in the neck of a glass funnel, and passing the iodizer through it, laying a glass plate over the funnel to prevent evaporation.

The iodizer being added to the collodion, shake up thoroughly, and allow to stand for a week to settle, then decant into convenient sized bottles for using; this collodion is ready for use in a week, and will improve with age up to 6 months, after which time it should be mixed with new.

Beginners will perhaps find it advantageous to buy their collodion at first, in which case, Mawson and Swan's collodion made for photo.-litho. work will suit them. The collodion is sent out in two solutions, which must be mixed in proportions of three parts collodion to one of iodizer, the mixture being well shaken, and allowed to stand a week to ripen. When so iodized, this collodion will keep good for three months, after which it should be mixed with freshly iodized; as sent out, the two solutions keep for a long time.

When coating plates with collodion, it is not a wise plan to pour the surplus from the plate back into the bottle from which it was poured, but to pour it into another, kept handy for the purpose, the contents of which, are, at the end of the day's work, emptied into the stock bottle, after such a quantity as is sufficient for next day's consumption, has been decanted into the pourer.

The best bottle from which to pour the collodion upon the plate is the tall capped bottles sold by the dealers as collodion pourers.

THE SILVER BATH.

The Silver Bath is a most important factor in the production of good negatives, and must be compounded with care and used with skill.

To make it, dissolve 6 ounces of nitrate of silver in 10 ounces of water, add 10 drops of iodized collodion, shake up well, then add 70 ounces of water, and let it stand all night; then filter through a pledget of cotton wool, packed loosely into the neck of a glass funnel, into a clean bottle or jug, such bottle or jug being kept solely for use with the silver bath, as also the glass funnel; then add one dram of nitric acid, and let stand all night before trying.

The bath holder may be an upright vessel of the ordinary pattern, with a dipper with which to lower the plate into the solution ; or it may be a flat dish, with a cover, to keep out light and dust, and using a silver hook to lift the plate from the solution ; if the former shape be chosen, let the dipper be of glass, porcelain, silver wire, or of wood, soaked in melted paraffin, but on no account of ebonite, as such a dipper will cause spots, and derange the bath sooner or later.

If a flat bath be used, the best form is that introduced by Mr. H. J. Burton, principal operator of the Autotype Company, which is a wooden dish lined with asphaltum, hanging on a cradle, the lower end being a well to hold the solution ; in this form of bath, the plate after sensitising, is drained thoroughly, before taking it out, which is a great convenience, as not only is the silver solution saved, but the dark slides will last much longer.

The Bath solution made up as above will be the right strength for work, but as every plate sensitised therein takes away its modicum of silver, after a certain time it must be strengthened, as it is essential for the production of good work that the solution be kept at a proper strength. The best way of doing this, is to add a dram or two of a saturated solution of nitrate of silver, after each day's work has been done, and if a solution be worked in a flat bath, it will be as well to pour it into a jug and filter it before using again ; with an upright holder, this filtering will only require to be done about once or twice a month, as any particles of dust, &c., subside, and have not the same chance of falling upon the film as in a flat bath, but the addition of the silver solution should be made, and the solution well stirred up with the dipper.

In course of time, a silver bath will get contaminated with organic matter from various causes, and will also get supersaturated with ether and alcohol, and also with Iodo-Bromo-nitrate of zinc, and will either refuse to work, or only yield imperfect films, and thin images, in which case the best plan will be to take 20 ounces of the solution, dilute it with clean water 60 ounces, filter, add 6 ounces of nitrate of silver and again filter, when a new bath will be the result.

The silver in the rejected portion of the old bath should be precipitated as a chloride, by the addition of a solution of common salt, the precipitate dried, and sent to the refiner, together with the ashes of the filtering papers, blotting paper used to drain the plates upon, or to wipe the backs of the plates, after leaving the bath, and before putting into dark slide.

The Nitrate of Silver Bath, may be made up with distilled water, *if pure*, that is, if the water is bona-fide distilled, and not merely from waste steam; if this cannot be guaranteed, the best plan will be to get a gallon of tap water, dissolve in it one ounce of nitrate of silver, then add saturated solution of bicarbonate of soda, until it shows an alkaline reaction to litmus paper, then place the lot in white glass bottles and expose to the action of light for three or four days, during which time the solution will first of all turn black, and then will gradually become quite clear, the organic matter—which, if not removed, would have caused trouble—falling in a black mass to the bottom.

Now filter the purified water and use it for compounding the Nitrate of Silver Bath, but do not use it for any other purpose.

The strength of a Nitrate of Silver Bath, for line work, should be 30 grains of nitrate of silver to each ounce of water, and should not be allowed to fall below twenty-five.

Be sure and keep all funnels, bottles, and dishes used for the silver bath, separate and distinct from all others, and never use them for any other purpose.

THE DEVELOPING SOLUTION.

First of all purchase 7 lbs. of commercial sulphate of iron (copperas) put this into a gallon jug, fill up with boiling water (clean) stir up with a clean rod, at short intervals for 3 or 4 hours, then allow to stand until the sediment settles, and the top portion of solution is clear and bright, then decant as much as possible into a bottle or bottles, and label "Saturated solution of Iron," then again fill up the jar with boiling water, stir until as much is dissolved as possible, so as to be ready by the time the stock in the bottle is exhausted, repeating the process until all the crystals are dissolved; then wash out the jar, rejecting the residue, and begin again.

But bear in mind, that unless there are crystals left in the solution after each addition of hot water, it will not be saturated, therefore before taking the solution into use, be sure there are undissolved crystals in the jar.

For use, take of—

Saturated Solution of Iron ...	10 ounces.
Acetic Acid	4 ounces.
Water	70 ounces.
Methylated Spirits of Wine—1 ounce to 5 as required.	

In the above solution, the alcohol is added to enable the developer to readily assimilate with the sensitive film, and

the quantity requisite, varies with the age of silver bath, or to be more correct, with the quantity of plates sensitised therein. At first, little or no alcohol will be required, but after a number of plates have been sensitised, the developer refuses to flow evenly, and seems as though it wants to run over the edges of the plate ; this is a sign that more alcohol is required, and when more has been added, the developer will flow evenly as before, but when 80 ounces of developer require over 4 ounces alcohol to make it flow, it is a pretty sure sign that the bath wants re-making.

The developer is applied to the plate after exposure from a straight lipped cup, or glass measure, which should be kept for the exclusive use of this solution, as the mixture of any of the other solutions with it, will at once counteract its working power.

THE FIXING OR CLEARING SOLUTION.

Cyanide of Potassium	...	...	3 ounces.
Water	...	...	20 ounces.

This solution is highly poisonous, both in solution and vapour, so ought to be kept in an upright holder, the plate being lowered in the solution on a dipper ; keep the solution well covered up, so as to prevent evaporation as much as possible.

After being in use a little time, this solution will get weak, and should be strengthened by the addition in the evening, of a lump or two of Cyanide, and then stirred up with the dipper in the morning : the negative must not be left in this solution too long, or the density of the film will be impaired, but must be removed, and well washed, directly all the yellow iodide has been dissolved.

THE INTENSIFIER, No. 1.

Water	...	...	...	80 ounces.
Chloride of Ammonium	2 ounces.

dissolve, then add—

Bichloride of Mercury	2 ounces.
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dissolve, and filter.

No. 2.

Liquor Ammonia 880	5 ounces.
Water	20 ounces.

Solution No. 1 is best kept in an upright holder, as if kept in a flat dish there is always a danger of cutting the skin with the glass plate, and getting the mercurial poison into the system.

No. 2 is kept in a well stoppered bottle, and only sufficient for each plate, withdrawn as required.

Another method of intensifying for those who object to the use of mercury, is to bleach the negative in a solution of—

Ferrid Cyanide of Potassium				} 6 parts.
<i>Red Prussiate of Potash</i>	...	...	...
Nitrate of Lead	...	...	...	4 parts.
Water	...	...	...	80 parts.

dissolve, and filter—

When the plate is bleached, wash thoroughly under the tap, taking care that the edges and corners of the film are washed, as well as the centre, then flood with a sufficient quantity of—

Nitric Acid	...	...	...	1 ounce.
Water	...	...	...	80 ounces.

allow this to remain on a few seconds, wash, and flood with sufficient quantity of—

Sulphide of Ammonium	...	1 part.
Water	... ..	5 parts.

which will at once turn the film an intense black ; wash and flood with the Nitric Acid Solution, and again wash : then the negative is put away to dry.

This method of intensifying is cheaper than the other and, if the washes of acid between, and after, the other two solutions are carefully done, and the stench of the sulphide not objected to, then there is little or no difference in the results, but if the acid washes are omitted, or the sulphide has not been kept corked, and is consequently not fresh, then there is a great danger of a brown stain upon the lines which is more or less fatal to getting a good print on zinc.

PROTECTING THE COLLODION FILM.

A Collodion film when dry, is very delicate, and, except for line work in the hands of an expert—will require protecting. This is usually done by slightly warming (when quite dry) in front of a fire, and then pouring over a sufficient quantity of thin spirit varnish, which, after the superfluous varnish is drained off, is dried by again holding in front of the fire ; the spirit varnish answers perfectly for ordinary work, but for printing upon metal for relief blocks it will be best to use a Benzole varnish, such as sold by dealers, for protecting the films of glass positives, or of Ferrotypes pictures, and used cold.

But the best plan of all, is to use a water varnish, made by dissolving half an ounce of Borax in a quart of boiling water, then adding, a few pieces at a time (stirring meanwhile) 1 pound of ordinary shellac ; if the quantity of borax named, does not suffice, to make all the shellac dissolve, add more, a grain at a time, until the shellac is dissolved, now add half an ounce of white sugar, then allow to cool and filter.

When the negative is washed for the last time, allow it to drain, then flood with the above solution, and let it dry. This will be found a quicker, cleaner, and more satisfactory method of protecting the delicate film, than the spirit varnish.

THE GLASS PLATE.

The glass used as a support for the collodion film should be thin flatted crown, of the best quality, the negatives as a rule, not being required again, after once the zinc is etched, the film is washed off, and the glass used again which cannot be done so often if the glass is of bad quality ; flatness is a *sine qua non*, as it has to be subjected to heavy pressure between a zinc plate, and the front glass of printing frame.

As a good and suitable negative is the foundation of success in the subsequent processes, so is a properly cleaned glass plate the foundation of a successful negative ; unless the glass is chemically clean, the collodion film will either be stained or marked, or it will split off in drying, therefore care and attention are requisite, even in preparing a piece of glass for the reception of the film of collodion ; care is especially requisite, as the want of it cannot be seen until all the operations have been gone through, the labour and time being thrown away.

There are two methods of cleaning the glass plate, one method quite mechanical, the other a mixture of the mechanical and the chemical, both are good, the second being perhaps the best, as it is simple and more certain.

In the first method, the glass, when new, merely requires polishing with a clean wash leather kept for this purpose only.

The best way of doing this is to cover a flat board 24 by 18, or thereabouts, with a good American cloth, glazed side out, a plate laid out upon this will not slip about when being polished.

Both sides and edges of the plate must be well cleaned, as one of the most prolific causes of derangement of the silver bath, is from organic matter introduced therein, by imperfectly cleaned glass plates.

One side of the plate, if gently rubbed with the thumb nail, will be found smoother than the other, this being the suitable side for the support of the collodion film; this side is polished with a leather until, upon breathing gently upon it the film of moisture is quite free from marks or streaks, not only in the centre, but at the sides and corners.

It is absolutely necessary that the plate be chemically cleaned all over, else the film of collodion, upon drying, will split, and the negative be spoilt.

When the plate is clean, an edging about an eighth of an inch wide of india-rubber, dissolved in benzole, is run all round the edge, by means of a small camel hair brush, tied to a stick, the end of stick being level with point of brush, the stick acting as a guard against the brush going too far from the edge.

In the second method, the new glass plate is soaked an hour or two in a mixture of 5 ounces of common spirits of salts (Hydrochloric Acid) in 80 ounces of water, both sides of the plate are rubbed with a rag, then well washed under the tap, and put into a dish of clean water, when all the batch have been so treated, they are taken out singly, again well rubbed on both sides with another rag, again well washed, then the smoothest side having been selected, it is flooded with a mixture of albumen and water, twice, draining the surplus into the sink each time of flooding; the plate is then placed upon a rack to drain and dry; the drying being effected in a hot current of air, free from all dust.

The albumen mixture is composed of white of one egg well beaten up either with a stick, a fork, or an egg beater, then diluted with 40 ounces of water, and ten drops of Liquor Ammonia added, and again beaten up, it is then very carefully filtered through cotton wool, and used as above.

In placing these plates, so coated with albumen, upon the drying racks, care must be taken to face the coated sides all one way, as when dry there is nothing to indicate to the eye which is the back, and which the front.

These albumenized plates, when dry, should have the backs cleaned with a cloth, or a leather, before using, so as to clear away any albumen, which may have got there during coating.

Albumenized plates stored in a dry place will keep good for months, *and do not require any edging with india-rubber*, as the most horny collodion film will not split off a properly albumenised plate.

Glass plates that have been used, and not varnished, are freed from the films by being immersed in a mixture of Hydrochloric acid and water for a few hours, then washed under the tap, and well rubbed with a rag, then put into clean water, from which they are taken singly and coated with albumen, or they may be allowed to dry, and then polished by means of the wash leather, &c.

Plates that have been varnished with spirit varnish, must be soaked in a hot solution of washing soda, until the film floats off, then wash well under the tap, rubbing with a rag and immerse in the acid as above.

CHAPTER III.

Photographic Manipulations.

THE chemicals being prepared, they must be placed in a dark room, the collodion bottle should be placed on a convenient shelf close to the door, and on handy peg hang a broad camel or badger hair brush, for dusting the clean plate, just previous to coating with collodion ; which brush must be kept for this purpose only, and not used for anything else, upon any pretence whatever. The Silver Bath must be kept, both in use, and out of use, in some convenient corner, where there is no risk of getting any other chemical splashed into it. For a bath holder, a deep 15 by 12 porcelain or papier machie dish, provided with a wooden or stout cardboard lid, should be provided, and this dish must always be thoroughly washed, and wiped dry with a clean wet leather (kept for the purpose), both before use and after, pouring the silver solution back into its bottle or jug.

The developer should be placed on a shelf, on the right of sink, the developing cup close to.

The Fixing or clearing solution should be kept in an upright bath of glass, porcelain, or ebonite.

The intensifier No. 1 may be kept in a flat dish, or an upright holder, at discretion, but if in a flat dish, the solution should be poured back into its bottle, after each day's work.

Intensifier No. 2 being kept in a stoppered bottle close to the sink.

The water varnish also is kept in a bottle or jug handy for use.

On a shelf close to the collodion, the polished or albumenised plates may be stacked close together, with the clean or prepared side facing the wall.

A pneumatic holder for attaching to the back of the plate during the operation of coating with collodion will be found very handy.

Of course it is thoroughly understood that there is a sink in the dark room, and also water laid into the sink, as a good supply of water is indispensable.

Then again, the window through which the light is transmitted, must be covered with a non-actinic medium, such as two thicknesses of golden fabric, or one of canary medium ; do not stint the amount of light, but have as much as possible, as long as it is non-actinic.

Everything being in readiness, we will now proceed to make a line negative, reserving a description of half-tone work to the proper place.

Now to begin work : wash the bath holder thoroughly, and wipe it dry, then pour into it sufficient silver solution to make the depth about half an inch, dust the inside of cover,

and put it over the dish ; now take a clean glass plate, if it be polished, see that it is edged with india rubber, and if albumenised, be sure and clean the back—and attach to a pneumatic holder, then with a broad camel, or badger hair brush (kept for the purpose only), remove any particles of dust, first on back of plate, then on the front ; now hold the plate in a horizontal position, and pour upon the plate, towards the right hand corner furthest away from the body, a little more collodion than it is judged will be sufficient to cover the plate, let the collodion run to the corner, then incline the plate to the left, and the collodion will run into the upper left hand corner, now by inclining towards the body, the collodion will flow into the lower left hand corner, and from thence it is guided into the funnel placed in the bottle prepared for its reception ; during the time that this surplus is draining, the plate must be gently rocked sideways, so that the lines formed by the collodion in draining, are merged into each other, leaving the film quite homogeneous ; as soon as the collodion ceases to drip, release plate from pneumatic holder, and touch the lower ridge of collodion, and when firm, close the door of dark room, remove the lid from the bath holder, then—holding the plate in the left hand—with the right hand raise the bath holder as far as possible without risking any of the silver solution running over the side of dish resting on bench, now lay the plate (with the collodion side up) on the bottom of dish, then drop the plate into the solution, and at the same time lower the end of dish held up by the right hand, which will cause the silver solution to flow in one even wave over the collodionised surface. This operation must be done with dexterity, as if the silver solution does not flow in an even wave, the film will be marked, and in the case of a half tone negative, the image will be spoilt, therefore it is necessary to see that the plate and dish

are lowered simultaneously, so that the solution goes over the collodion film in one steady wave.

The plate will require an immersion of about 3 minutes for proper sensitising, and this interval—the Bath being covered up to prevent the access of white light—may be utilized to give the final adjustment to the camera, and to see that the drawing or print to be copied is properly in focus.

Use a medium Diaphragm in the lens for focussing, and examine the image all over before deciding that it is sharp, focus by preference about half-way between centre of picture and the edges, and when after moving rack to and fro until the proper sharpness is obtained, take out the Diaphragm, and substitute the smallest sent out with the lens, or if the picture to be taken be small, and from a large original, then the second or third smallest may be used.

Now remove the focussing screen from the Camera, (note that the ground side of glass has been next the lens) and place the cap upon the lens, close the door of the dark room, open the dark slide, see that the proper carrier is in it, then raise the plate from the bath slowly, using a silver wire hook for the purpose, and if the solution flows evenly over the film, the plate is ready, but if on the contrary the solution flows greasy, then again lower the plate, and rock the dish gently for a minute or two. The film being fully sensitized, the plate is carefully lifted out of the solution, both hands holding the plate in such a manner as to avoid touching the film, allow the solution to drain from the plate as much as possible, then lean the plate against the wall, the lower end resting upon a pad of clean blotting paper, or papier-joseph, wipe the back of plate as dry as possible, which will prevent stains and keep the dark slide from rotting by the action of the silver solution.

The plate being grained, lay a piece of thin filtering paper in each lower corner of carrier, so that the plate will rest upon the filtering paper, which will catch any further drainings from the film, and be a safeguard against stains.

Now lay the plate face down in the carrier of dark slide, close the door and fasten it.

The dark slide is now carried to the Camera, and inserted in the grooves previously occupied by the focussing screen, taking notice that the sliding shutter is next the inside of camera ; when pushed quite home, cover the back with the focussing cloth ; pull out the shutter when the plate is ready for the exposure.

The time of exposure will vary very much with the time of the year, and with the amount of light falling upon the object being photographed ; the exact time can only be found out by actual practice, but the operator in time, by observation, will be able to guess it pretty correctly.

In taking the cap off the lens, be sure that the camera is not shaken, else the picture will be spoilt.

The exposure being made, close the sliding shutter, remove the slide to the dark room, and close the door, lay the dark slide (with sliding shutter down) upon the bench, open the back shutter, and placing pneumatic holder in centre of plate, lift it out of the carrier.

Take the plate to the sink, and holding it face up in the left hand, take the developing cup in the right, and with a quick motion pour over the plate sufficient developer to cover the whole film ; the developer must go all over the film in one even wave, any hesitation in this will result in a stain ; pour upon the film only sufficient to cover it, and be careful to spill as little as possible into the sink, or else the image

will be thin, on account of the absence of free silver washed off by the wave of developer.

Now rock the plate gently, so as to keep the developer flowing to and fro over the film (but keep it there, don't spill it off) and the image will soon appear, faint at first, but growing gradually darker, the black lines of drawing being white and the white paper black, and if the development be continued too long, the lines will eventually be veiled, therefore as soon as the finest details are out and well defined, place the plate under the tap and allow the water to well sluice the film all over ; as soon as properly washed, which can be seen by the water flowing evenly over without greasy looking lines, hold the negative up in front of window, and examine for spots or stains, as if there be any present that at all interfere with the picture, at once reject the negative, placing it in a pan filled with water to be washed off at leisure, and start afresh.

The negative being satisfactory, give it another rinse under the tap, and place it in the Cyanide Bath, where the unaltered iodine will speedily be dissolved, then it is withdrawn, and well washed under the tap, and whilst the water is washing over the front, rub the back with the fingers or a sponge, and then turn the plate over and allow the water to wash the back also, it is now ready for immersion in Intensifier No. 1, where it remains until the film is bleached almost white, when it is thoroughly washed, drained, and flooded with a small quantity of Intensifier No. 2, which will at once turn the film to an intense black, or if the action does not penetrate through to back of film, continue the application until it does, again wash, then place the negative on a rack to drain, and when the water ceases to drip, flood the plate twice with the filtered water varnish, then place the negative on the rack to dry.

When the negative is dry, it is ready for printing on zinc ; the negative may be varnished with a Benzole varnish, sold by the dealers under the name of positive or Ferrottype varnish. Negative varnish may be used, but unless very thin, it is apt to be sticky, and render the negative easily marked by the heavy pressure it is subjected to in the printing frame.

Now lay the finished negative, face down upon a piece of clean white paper, when, if it is a good one, all the details of the original will show through, clear and distinct, but if any of the details are missing or veiled over, the negative will not do, and another must be made.

This process does not always work satisfactorily, but with care and cleanliness no serious fault should arise.

Sometimes the bath may give what are called foggy images, which is indicated by a veil over the lines, which can often be wiped off with a pledget of cotton wool, in which case the addition of $\frac{1}{2}$ a dram of nitric acid to the 80 ounces of solution, thoroughly mixing this up, and a rest for a few hours will thoroughly end the difficulty. If the dark room window be not of the proper color, fog also will ensue, therefore the non-photographic experimentalist had better call in the aid of a professional photographer, in case of any difficulty in getting clear negatives.

At the end of each day's work, the silver solution should be carefully poured into the jug or bottle, and allowed to stand all night, then in the morning, just before using, it should be filtered. The dish also must be carefully washed out and put away in a corner where it has no chance of being splashed into.

In the Appendix will be found a chapter devoted to the full management of this important factor, in the production of a good wet collodion negative.

CHAPTER IV.

NEGATIVES ON DRY PLATES.

The object of this chapter is to teach how negatives are made upon dry plates from drawings, in line, dot, or stipple, (washed drawings, or ordinary photographs being unsuitable) for printing from on zinc, for subsequent etching in relief.

In the original drawing, the lines are black on a white ground, in the negative this is reversed, the lines being white, or transparent, and the ground black, or opaque, or nearly so; a perfect negative having absolutely clear lines, with jet black ground, but, owing to many causes, the ground cannot always be got quite opaque; this is not very important, the clear lines however can easily be obtained, and are absolutely necessary, any veil or fog, upon them, being sufficient to spoil the negative.

In the wet process, the sensitive plate must be prepared and finished within a short time, as they do not keep, and cannot be prepared in advance; dry plates are purchased ready for use, and will keep any reasonable length of time, if shielded from light and damp. Dry plates are sold in boxes containing one dozen, in the following standard sizes—

Quarter Plate	...	...	$4\frac{1}{4}$	+	$3\frac{1}{4}$
Half Plate	...	...	$6\frac{1}{2}$	+	$4\frac{3}{4}$
Whole Plate	...	...	$8\frac{1}{2}$	+	$6\frac{1}{2}$
			10	+	8
			12	+	10
			15	+	12

Larger or intermediate sizes being prepared to order

These boxes must not be opened except in the dark room, as the slightest exposure to even the faintest ray of white light is sufficient to utterly spoil them.

For negatives, suitable for printing upon zinc, *the ordinary dry plates of commerce are perfectly useless, and nothing but failure and waste can attend their use.* The plates to be used are England's Rapid Chloride, and Mawson and Swan's Photo Mechanical, these plates yielding as good results as wet collodion.

The dark room must be roomy and well lighted, the window being covered with 3 or 4 thicknesses of golden fabric; so long as the light is non-actinic too much cannot be admitted, and it is absolutely necessary, to have sufficient light to see the progress of the development.

The above alludes to gelatine dry plates suitable for photo-mechanical work only, if it is desired to use ordinary gelatine dry plates in the same dark room, a blind of ruby, or orange fabric, must be provided.

Photo-mechanical plates must not be manipulated in the subdued light necessary for the rapid ordinary plates, so this blind must be moveable.

For developing dry plates, a shallow dish is required, and to prevent waste of solution, a separate dish is used for each size of plate, these dishes are sold in glass, porcelain, ebonite, in papier mache, and in tin, japanned; the last are cheapest, and quite as good as any of the others; for fixing and clearing, &c., porcelain dishes, large enough to contain the largest plate likely to be used, should be provided.

A remote corner of the dark room away from all chances of stray light, or splashing from the taps, should be chosen, for the operations of opening the box containing the dry plates, and putting them into the slide, previous to exposure.

The developing solutions are mixed as follows :—

DEVELOPER No. 1.

Hydrokinone	...	...	80 grains
Meta-bi-sulphite of potash			80 grains
Bromide of Potassium	...		5 grains
Water	...	...	20 ounces

Dissolve and label No. 1.

DEVELOPER No. 2.

Caustic Potash, pure stick			200 grains
Water	...	...	20 ounces

Dissolve and label No. 2.

THE FIXING SOLUTION.

Hypo Sulphite of Soda	...		4 ounces
Water	...	...	20 ounces

This should be mixed in a jug, and only sufficient to cover the plate poured into the dish, as it gets discoloured by the developer, and needs changing each day.

THE CLEARING SOLUTION.

Powdered Alum	...		4 ounces
Hot Water	...		20 ounces
Nitric Acid	...		10 drops

This solution is best kept in a bottle, and poured into the dish each day as required. Must be *cold* when used.

These solutions, and a glass measure, are placed close to sink, then the door of dark room is closed, a box of dry plates opened, the top one removed, dusted with clean dry camels' hair brush, and placed film downwards in the slide, which is then closed : the dry plates are re-packed, and the loaded slide taken into the studio.

Put the mirror into its box, pin up the drawing on the easel, and adjust the camera so that the image on the

focussing screen is the required size, the nearer the camera to the easel, the more the bellows are extended, the larger will the image be, and vice versa.

For focussing by, use a stop of medium size, and focus the image about half way between the centre and edges, when satisfactory, remove the stop and substitute the smallest one in the case, put the cap on the lens, take out the focussing screen, and put in the dark slide; draw out the shutter, and make the exposure, removing the cap gently, so as to avoid shaking the camera; the slightest vibration during exposure being sufficient to spoil the negative; the exposure varies with circumstances, but as a beginning, about three minutes will serve as a guide.

The exposure being complete, re-cap the lens, close the shutter, and remove the slide to the dark room.

Now into a clean measure, pour one ounce of developer No. 1, and half an ounce of No. 2, this for a half-plate, larger plates will require more in proportion, now close the door of dark room, take the plate from slide, and put it face up in the developing dish, then pour the mixed developer over the plate, examine the film closely for air bells, and if any have formed, touch them with the finger, now rock the dish gently, and if the exposure has been right, the image will begin to appear in about 60 seconds, and will gradually grow in brilliancy.

When all details are well out, put another half-ounce of No. 2 into the measure, and return the developer to it, mix, then return to the dish, and continue the development till the ground of picture is quite opaque, then throw away the developer, and wash the plate under the tap; then immerse in the fixing solution, where it will remain until the milky appearance has quite gone.

If the image flashes out soon after the application of the mixed developer, the exposure in the camera has been too long, and the result is useless; if the image appears very slowly, add the other half ounce of No. 2, adding more No. 2 if there seems any chance of the image developing up to any strength; the solution No. 2 being the accelerator, by judicious use, an under exposed plate may often be saved.

When the negative is fixed, remove it from the hypo. and wash, put face down upon a piece of clean white paper, and examine the image, if the lines show up clear and distinct, the negative is all right, but if veiled or cloudy, then it is useless. Now hold it up to the light, and see if the ground be black, or nearly so, if it be thin and grey, it has not been in the developer long enough.

Examine also for sharpness, every line, from corner to corner must be sharp, any fuzziness being quite inadmissible. The negative passing muster, is washed under the tap for a few minutes, is then immersed for one minute in the clearing solution, after which it is well washed under the tap, then put on a rack to dry.

CHAPTER V.

PRINTING ON ZINC IN ALBUMEN.

A negative, answering all requirements set down as necessary in the two last chapters, having been obtained, the next step will be to produce from that negative, a replica of the original drawing, in ink, upon a sheet of polished zinc.

Zinc Plates, suitable for Photo-engraving can be obtained either in large sheets, or cut to size as ordered, and when new, require polishing with a damp rag, dipped in levigated pumice powder, *i.e.*, the pumice powder washed in water, so as to get rid of any grit that may accidentally have fallen in.

Lay the plate upon a polishing board, covered with American cloth, and polish with a from and to the body motion, not circular; do not use a great deal of pressure, the object being to get the plate highly polished with a perfectly smooth surface.

Plates that have been printed upon, and are not satisfactory, are cleaned off, and re-polished in the same manner.

Plates that are scratched, will require polishing with emery cloth to remove the scratches, which would otherwise interfere with the picture.

To remove these scratches, sprinkle the face of plate with turpentine, then rub with a piece of FF emery cloth (this is Oakey's brand, other makers brand theirs of the same degree in other ways) stretched over a carpenter's cork covered rubber, use the same motion, to and fro, until all the turpentine has evaporated, and the surface of the zinc polished, and if the scratches are removed, the plate is ready for use, but if not, then the operation must be repeated. If the scratches are too deep for emery cloth, the scratches must first be removed with a piece of fine pumice stone, followed by snake stone, then by pumice powder, rotten stone and rouge: too much care cannot be taken with the zinc plate at this stage, as if after the block is etched it is discovered that the plate has not been properly polished, all will have to be done over again, entailing a loss of time, labour and materials.

Remember, that no matter the polishing agent used, the plate must be polished with a to-and-from the body motion, not a circular motion, as is the usual method of polishing.

GRAINING THE PLATE.

The next operation is to give the plate a slight tooth, so that the sensitive solution will flow evenly over the surface, by removing all traces of grease that may chance to be on the surface.

This graining is done in a wooden tray, 24 inches by 18 by 9, lined with pitch, and mounted upon rockers ; it is quite necessary that the graining tray be of a large size, as if only a little larger than the plate, the returning wave of acid water, will mark the edges of the zinc.

Into this tray, pour a quart of clean water, add 1 dram of nitric acid, and 1 ounce of a saturated solution of common alum, place the zinc, face up, on the bottom of tray, commence rocking at once, or else the acid will mark the surface, and it will require re-polishing ; rock slowly for five minutes, during which time the polished surface will give way to a fine matt, like fine frosted silver, now remove the plate, and rinse under the tap, rubbing gently with a fine sponge, or a pledget of cotton wool, to remove the scum or deposit formed by the acid. The surface at this stage should be quite smooth ; if it is at all rough, the acid is too strong, and the solution must be diluted with water ; if the action of the acid is very slow, then a little more acid must be added, but it will only be necessary to add more alum when the plate is a bluish colour, instead of being a pearly grey.

A drop or two of acid will be required each time a plate or batch of plates are to be grained.

In rubbing with sponge, or pledget of cotton wool when under the tap, care must be taken not to scratch the surface of zinc, or it will need re-polishing.

If the solution of albumen be poured over the plate, drained, and dried, the film would be too thick at the bottom, and too thin at the top ; it is therefore necessary, in order to ensure an even film of sensitive albumen, to subject the plate to a quick circular motion, so as to spread the film of albumen evenly, and to get rid of the surplus solution not required, this is effected by placing the grained zinc in the jaws of an instrument called a whirler, made as follows :—

Two pieces of wood, each half an inch thick, twelve inches long, nine inches wide at one end, and six inches at the other ; upon the narrow end of one piece fix with four screws, a piece of iron the shape of a \perp the top end of which is shaped to fit into the socket of a common carpenter's brace, (which must have the centre handle revolving, not fixed like some of them are) the cross being flat, and pierced with four holes, countersunk to admit of stout screws to go through.

This being done, place the two pieces of wood together, the \perp piece between the two, and with a piece of stout leather, hinge the two together, nailing the leather not only on the outside, but upon the top also ; now screw a narrow batten on each of the pieces, about an inch from the widest end, to keep the wood from warping.

Four inches from top (the hinge being the top) bore a hole right through both pieces, and pass through a couple of strong leather laces, fix one end of these on the outside of the cheek to which the iron \perp is screwed, and on the outside of the other cheek, seven inches from top, hinge a piece of wood (so as to fall towards bottom) 5 inches by $2\frac{1}{2}$; and in centre of the batten screwed on to prevent warping, fix a broad headed nail, or a turn button, over which the free end of the leather laces can be passed.

Now about half an inch from each end, drive, in a straight line right through the wood, 6 or 8 wire nails one inch long, so that the points project on the inside of each cheek, now fix the top of iron into socket of brace, and the thing is ready for use.

To use this instrument, lay it upon the bench, raise the upper jaw, place the grained zinc behind the teeth (face out) close the jaw, and after seeing that the face of zinc is close up to the teeth, tighten the shoe lace, pass it over the hinged piece, (which is lying down close to the cheek) and round the screw on batten with two or three turns, then pass it back, and tie the loose ends round the iron shank at top, then raise the hinged piece, which by straining on the leather laces will cause the jaws to grip the zinc tight and hold it in position. See figure 2.

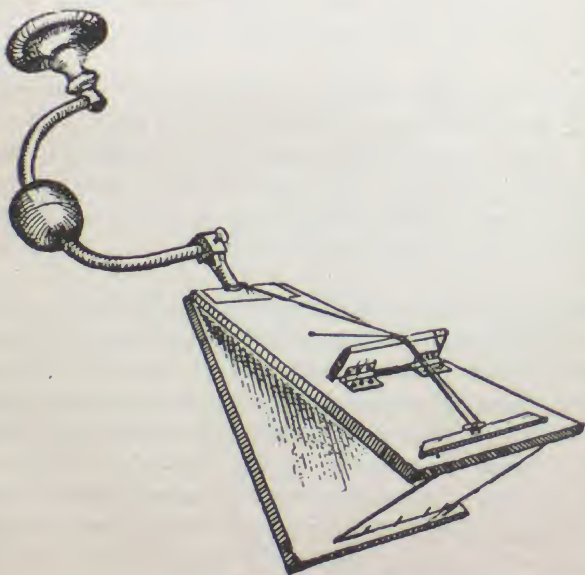


FIG. 2.

Now lift the whirler from the bench, grasping the handle of brace, firmly in the right hand, hold it at arm's length, and by a series of quick jerks, set the plate revolving, this will require a little patience to do evenly and rapidly, but with a little practice it will be quite easy.

The plate is coated twice, whirling it after each application of the sensitive mixture, then the whirler is laid upon the bench, the hinged piece let down, which, relaxing the strain upon the leather laces, will allow the jaw to be lifted, and the plate removed.

DRY THE SENSITIVE COATING.

The film of albumen now requires drying, which should be done over a spirit lamp, the best form of which, is one of the small pocket spirit stoves sold at the ironmongers at 1s. and 1s. 6d., having the three supports for a kettle cut away. The zinc is held over the flame, and kept in constant motion, so as to dry the film as quickly and evenly as possible ; no fear need be felt at applying too great a heat so long as the metal can be held comfortably in the fingers ; when dry, the plate is ready for printing upon.

For drying large plates, two or more of these stoves would be required, but it is very easy to extemporise a suitable arrangement, by laying a large pad of cotton wool in a flat tin dish, saturating with Spirits of Wine, and setting it on fire ; by this means, a stove of any desired dimensions can be prepared quickly. To extinguish such a flame, cover it with a large sheet of zinc when finished with.

It must be borne in mind that the film on the zinc is now very sensitive to light, therefore the preparation of the film

must be done in a yellow light, as must also the operation of placing in the printing frame, inking up, and development ; gas, or lamp light may be used, as the film is not sensitive to artificial light of a low actinic power.

THE PRINTING FRAME.

The printing frames used for this process must be the box pattern, fitted with stout plate glass fronts, the cross bars behind being fitted with wooden screws, instead of springs, as absolute contact can only be obtained between the surfaces of the glass negative and zinc plate, by means of screw pressure.

The front glass of printing frame must be kept perfectly clean, and especial care must be taken that no grit be either upon the glass, or on back of negative, else the negative will be sure to smash.

TIMING THE EXPOSURE.

The time of exposure to light is measured by means of an actinometer, which is simply an instrument in which is a strip of sensitive paper, either under a graduated series of different thicknesses of translucent paper, each division of graduations being distinguished by a number thus :—No. 1 has only one thickness of paper over it ; No. 2, two thicknesses, and so on, but on account of the ever varying intensity of the light, a screen actinometer that is reliable is almost an impossibility, therefore the best form of actinometer is Johnson's single tint (sold by the Autotype Co. at 2s. 6d. each) its only drawback being that it must be closely watched in a bright light, so that the tints are changed evenly.

This actinometer is very simple and handy ; it consists of a cubical box with two lids, the inner one serving to press the paper in contact with the glass of outer lid, the outer lid has a circular opening with a narrow rectangular strip in

centre transparent, the rest of glass being covered with pigment, the colour assumed by the sensitive paper after exposure to the light, and when the strip of sensitive paper inside has assumed this colour, it is called one tint, the strip of paper is then pulled forward, and another portion, quite white is brought under the transparent portion of glass, and when the light has turned that the colour of the pigment, that counts two tints, and so on.

The exposure of zinc in the printing frame under a good line negative, will be about six or eight tints in diffused light, but in direct sunlight the exposure may be timed by the watch, a suitable line negative never requiring more than from one to three minutes.

INKING THE EXPOSED ZINC.

The sensitive zinc being exposed to light under the negative, the next operation is to cover the surface with a thin coating of Winstone's photo. transfer ink.

For this purpose we require a type printer's composition roller, mounted upon a litho stock. This roller must be perfectly smooth, cast in a solid mould, as the line along the side, formed by a split mould, would render it useless for inking up a zinc plate, a useful sized roller will be eight inches long, by five or six in diameter. We also require an inking slab, a palette knife, a bottle of turpentine, with the cork cut, so that the turpentine can be sprinkled out without having to remove the cork, a tin of Winstone's photo. transfer ink, and a linen cloth or two.

The inking slab may be made of smooth iron, or a suitable sized lithographic stone.

CHAPTER VI.

Printing on Zinc in Albumen. (*Continued.*)

SELECT a piece of zinc, a little larger each way, than the picture to be printed upon it, polish carefully (page 29), then grain (page 30), keeping the graining bath as weak as possible ; wash well under the tap, removing the oxide from surface with a fine sponge, or pledget of lint or cotton wool ; place in the jaws of whirler, face outward, rinse and whirl, so as to get rid of as much of the water as possible ; examine the plate, and if not perfectly smooth and free from grit, rinse again, and again whirl.

The platè is now ready for coating, with the sensitive albumen made as follows, and carefully filtered :—

Albumen of one egg	...	...	...	...	...
Water	...	...	...	...	... 10 ounces.
Saturated solution of Bichromate of Potash	...	...	...	...	... 1 ounce.

Place the white of an egg into a bottle, containing a lot of small pieces of perfectly clean glass, add the water, and shake up, for a minute, add the solution of Bichromate, again shake well, and add two drops of liquor Ammonia. Now place a pledget of cotton wool into the neck of a glass funnel, pass a few ounces of clean water through, (if this is not done there will be a difficulty in getting the albumen to filter) drain as much as possible of the water away, and filter the albumen into a clean bottle ; when all the solution has gone through, remove the cotton wool from the funnel, which well wash, then re-charge with a fresh pledget,

pass some water through, and again filter the albumen solution, this time into a ten ounce glass measure, which is to be used for pouring out of, upon the zinc ; the stem of the funnel should be long enough to reach the bottom of glass measure, so that the formation of air bubbles be avoided, which is impossible with albumen, if the funnel is not below the surface of the filtrate.

Of this, pour over the zinc sufficient to well cover the surface, letting any surplus go into the sink, set the whirler revolving, coat again, and again whirl : now examine the surface, and if free from dust, spots, and air bubbles, remove the zinc, and dry it over the spirit stove ; but if either air bubbles, or dust be present, wash off under the tap, and coat again.

The film being dry, get the printing frame ready, see that the surface of glass inside is quite clean, and free from grit, as also the back of negative, taking special care that the ridge of varnish which often forms at bottom of negative be removed, as the slightest inequality of surface will surely cause disaster directly the screws exert their pressure.

Do not lay the negative into the frame flat upon the glass, but slide it in from one side, so as to carry any dust away from the glass front of printing frame.

The negative being in the frame, film side up, place the coated zinc upon it, face down, judging the proper position and placing zinc flat down upon negative, now put a piece of brown paper over back of zinc, then place the back of printing frame in its place, fasten down the cross bars, and apply the pressure screws, evenly and gently.

Do not screw one side tight before the other has been touched, but screw down so as to tighten all as nearly level as is possible.

Even pressure being applied, see that the front of frame is clean, and then expose to direct sunlight for five minutes, remove the frame to the dark room, unfasten the cross bars and remove the zinc, taking great care to lift the zinc without scratching the film, against film of negative.

Now, after wiping the inking slab with a clean linen duster, place a piece of the photo. transfer ink about the size of a small bean upon the upper corner, sprinkle this with a little turpentine, and mix with the palette knife, until about the consistency of cream.

Spread some of this mixture as far over the inking slab with the palette knife as possible, distribute with the composition roller, rolling to and fro, across and diagonally, until there is a thin even coating of ink all over the slab (not touching the corner where the ink was mixed with the turpentine) and upon the roller; if the mixture is too dry and refuses to spread, sprinkle a little more turpentine, but do not use too much, else it will take a long time to evaporate.

The roller having a coat of rather moist ink spread evenly upon it, place the exposed zinc face up, on a piece of clean white paper, and proceed to roll briskly to and fro, using a moderate amount of pressure, until the whole of the turpentine has evaporated, leaving a thin coat of ink with an even matt surface, not thick enough to quite hide the yellow film of the sensitive albumen, as if it does, too much has been put on, and it will most likely smear in development.

If, after first applying the roller, the ink on the zinc seems likely to be too thick, at once wipe the roller dry, and then roll the zinc briskly, until the coat of ink is perfectly even, and the turpentine evaporated.

At this stage, every thing depends upon getting the coat of ink even, if there are patches of thick and patches of thin, sprinkle some turpentine upon slab, quickly charge the roller, and roll up the zinc again, until the coat of ink is thin and even.

An even coat of ink being obtained, the zinc is laid in a tray containing clean cold water of a sufficient depth to well cover the surface, with a pledget of cotton wool rub the surface gently, when the ink covering the albumen protected from light by the black portions of the negatives, will wash away, leaving the picture on the zinc in ink; if the finer details do not develop easily, continue the rubbing with the cotton wool, but be careful not to rub so hard as to scratch the ink lines.

All details being developed, rinse under the tap, and put away to dry, which at ordinary temperature will only be a few minutes.

The chances of failure in this portion of the process are, first of all, air bubbles, and dust spots in film, which will at once declare themselves, and for which the remedy is increased care and cleanliness.

If upon development some of these lines are missing, then the zinc, and the negative have not been in actual contact, or if the finer lines wash away easily, then the exposure has not been long enough, whilst if it has been too long, either the finer details are covered up, or the whole refuses to part with any ink.

A satisfactory print, showing all the lines in the original drawing, having been obtained, it is drained and dried as

quickly as possible ; now with a piece of fine sponge, cover the surface with a coating of gum arabic dissolved in water (the solution being about the consistency of cream).

Allow to dry in a cold current ; be sure and do not use heat, else the gum will split off, and bring the image with it.

CHAPTER VII.

Printing on Zinc in Bitumen.

THE process described in the previous chapter, is most suitable for printing on zinc, for blocks that are not overburthened with fine lines, that are intended for rough printing, and also, when from want of sunlight, and the exigences of business, the exposure has to be made by Electric Light ; but when the subjects are very fine, and the blocks must be of the very best, it will be best to print the image in bitumen, when the first etching can be done without having to ink up, previous to immersing in the Acid Bath (which must be done after developing the inked albumen image), so getting the sharpest possible results. and also securing a better depth to close work, than when the inking up has to be done previously.

The generally accepted idea of bitumen is, that it requires such a long exposure to light, as to be practically useless, except for direct sun printing, but that only stands good where the crude bitumen is used, and when too thick a film is upon the plate.

By preparing the bitumen as about to be described, and taking care to have a very thin film of the sensitive bitumen

upon the zinc plate, the exposure either to sunlight or electric light, is not more than double that of albumen.

There is one special virtue in a bitumen film, if by chance too much exposure to light has been given, a prolonged immersion in the developing liquid (turpentine), will remedy the defect, whereas if an albumen image be over exposed, it is quite spoiled, and the work must be done over again.

We are still upon the subject of line work, and the same class of negative laid down as desirable for printing with an albumen film, is necessary for printing in bitumen, *viz.*, the lines must be clear glass without veil, and the rest of negative must be sufficiently opaque to stop the passage of light.

The sensitive solution of Bitumen is made by procuring a small quantity of Photographic Bitumen or Asphaltum, from a good firm, and powdering it in a clean dry mortar. Now take a clean and dry glass beaker, half filled with Methylated Ether, and pour into it the powdered Bitumen, stirring with a glass rod for a few minutes, cover the beaker with a piece of thin sheet india rubber, and upon that place a piece of thick plate glass, so as to make the vessel as air tight as possible, and allow to stand a few hours, stir up again, and pour away the Ether, draining the liquid as closely as possible, so as to get rid of all those constituents which are soluble in the Ether. Now add more fresh Ether, stir up thoroughly, and again allow to stand and settle, putting on the cover as before, so as to prevent evaporation as much as possible. After again settling, the Ether is poured away, fresh Ether being added, the mass well stirred, and allowed to stand a few hours, all liquid, and semi-liquid matter carefully drained away, after which, the residue in the beaker is removed to a glass plate and spread out over its surface, so that any Ether remaining may quickly evaporate.

The object of thus purifying with Ether, is to get rid of those constituents of the Bitumen which are not sensitive to light, and as these constituents are soluble in Ether, whilst those sensitive to light are not, by getting rid of them we secure a film of Bitumen sensitive to the action of light right through.

When the Ether has evaporated, take of the residue, half an ounce, and dissolve in pure benzole, (free from water) 15 ounces, allow to stand all night, then filter through filtering paper (placing a sheet of glass over the funnel to prevent evaporation).

New zinc plates will require polishing first with rotten stone, and finishing with rouge, but plates that have been used should be first polished with fine emery cloth, followed first by pumice powder, then rotten stone, and finished with rouge, remembering that a circular motion must not be used.

If after polishing, the surface is at all greasy, immerse it in the graining bath of nitric acid, alum and water, wash well, and rub away scum, then with a perfectly clean piece of blotting paper, remove the water from surface ; dry over the spirit flame.

To coat a piece of zinc with Bitumen, place it in the whirler, and when fixed in position, dust the surface with a clean camel hair brush, flow over it sufficient of the filtered Bitumen solution in benzole, lower the whirler and set it in motion ; whirl rapidly for about a minute, which will equalize the coat or film of Bitumen, and get rid of superfluous solution. The plate when taken from the whirler, will be quite dry, and ready for putting at once into the printing frame.

As these Bitumen coated plates do not, like albumen, deteriorate by keeping, a stock of them may be prepared at

a time, and stored away in the dark till wanted, but great care must be taken, not to allow the slightest ray of daylight to fall upon them, else the action once set up, will continue, and spoil the plate.

On examining the zinc plate after removing from the whirler, it will be difficult to realise that there is really a sufficient film of bitumen on the zinc, but there will be quite sufficient to form a resist, if the proportions given are adhered to.

In printing upon bitumen from negatives that have been varnished, it will be as well to rub the varnished surface of negative, with a pledget of cotton wool dipped in dry French chalk.

The same care in putting into printing frame, as enjoined in the chapter on zinc printing with Bichromated Albumen, is requisite with these plates, as also is the putting on of pressure by means of the screws.

The exposure to light will vary from ten minutes in the sun, to two or three hours in the shade.

DEVELOPING THE IMAGE.

These prints on zinc are developed by placing the exposed plate, face up, in shallow tin tray, and pouring into the tray sufficient turpentine to cover the plate, rock the tray so as to keep the solution in motion, and (if the exposure has been right) the image will gradually make its appearance, the bitumen protected from the action of light by the dense portions of negative gradually dissolving away ; as the development approaches completion, great care must be used, and when the last detail is visible, remove the plate, and rinse with water from a rose ; now if the image is quite perfect, immerse the plate at once into a mixture of Nitric Acid and water, the acid being just strong enough to just taste, keep the tray containing this acid solution rocking for about a

minute, remove the plate, and wash it thoroughly under the tap.

The immersion in the acid water will have removed the shiny appearance of the zinc, and the mat surface will enable the operator to see if all the requisite details of the image are visible, if not, and they are covered with bitumen, another immersion in the turpentine will complete the development, but if any of the lines are rotten, or the details dissolved away, then the exposure has been too short, and the plate will require repolishing, and another exposure made.

The image being satisfactory, the water is blotted off with clean blotting paper, and allowed to dry, (*don't use heat for drying*) it may then be exposed to light for a few minutes, but this is not absolutely necessary, although such exposure tends to make the image stronger.

The plate is now ready for etching in relief.

With regard to the keeping qualities of a solution of bitumen, as described in this chapter, my experience is, that it keeps in perfect condition for at least six months.

CHAPTER VIII.

Zinc Etching from Transfers.

THE foregoing chapters treat upon the production of relief blocks of line subjects, the same size, larger, or smaller than the original, the ink image being put upon the zinc by means of photography, but, when it is desired to make a zinc block by direct transfer to zinc without the aid of photography,

then the picture is drawn by the artist, if the subject is in line, on ordinary lithographic writing transfer paper ; if the subject is in chalk, the picture is drawn upon specially prepared transfer paper, like Josz's polygraphic transfer paper, or other grained paper made specially for the purpose, perhaps the subject is already on the stone, having been used as a Lithograph, or it may be a copper-plate engraving, in these cases transfers are made, put on the zinc, and etched into relief.

When the drawing is made specially for transfer to zinc, it should be made on writing transfer paper, if in line, or polygraphic chalk paper if in chalk ; taking care to avoid touching the surface with the fingers, as finger marks roll up black ; all lines must be firm, no attempts must be made to get effects by using pale ink. In chalk work also, the drawing must be firm and strong, corrections and alterations should be made on the transfer, and not left to be done after transferring ; if the corrections or alterations are small, they may be removed by inkeraser, or by careful washing with turpentine or benzole, so that all the ink is removed ; if the correction is large, a piece of clean transfer paper may be pasted over the place, using the paste as thin as possible ; *gum* must not be used.

The transfer being obtained, the next step is to transfer to stone, then after rolling up, and proving, a transfer is made on India transfer paper, and that transferred to the zinc.

If it is desired to make a type block on zinc, from an engraved copper-plate, a transfer must be made from the plate, on India or Scotch retransfer paper ; these transfers may be made on a copper-plate press, or on a Litho press.

The engraved copper-plate is first of all examined to see that all old ink is out of the lines, if not, wash with turpentine, and wipe quite dry, then tie up in a piece of linen rag some plate retransfer ink, warm the copper-plate either on the hot plate used during the etching, or over a bunsen burner, until it can hardly be held in the hand, hold it in a piece of cloth to protect the fingers, and rub in the ink until sufficient is melted to well cover the surface, taking care to see that the ink is rubbed well into the lines, take a piece of soft clean rag, and wipe off the ink from the surface of the plate carefully, so as not to remove it from the lines, this is best secured by wiping across the lines, not with them. When the plate is quite free from ink on the surface, rub the lower part of the palm of the hand, upon a ball of whiting, and proceed to polish the surface of the plate, do not get too much whiting upon the hand, else it may stick to the ink, and prevent it adhering to the transfer paper.

Now take a piece of clean transfer paper (India or Scotch) a little larger than the plate, and laying it face downwards upon a piece of clean paper sponge the back with a damp sponge, let it lie a few minutes, so as to get evenly damp right through.

See that the press is ready, if a copper-plate press is to be used, that the bed is free from grit, and that the blankets are in place; if a Litho press, put in a stone, wipe it free from grit, and see that the scraper is all right, remove the tympan, if of leather, and substitute one of zinc or millboard, now lay the inked and polished copper-plate upon the stone, then lay the damped transfer paper, face down upon the copper-plate, upon the transfer paper, place a piece of printer's blanket, turn down the tympan, or put a piece

of thin millboard over the blanket, run the bed of press under the scraper, turn down the lever, and if necessary, adjust the pressure (a good nip is necessary) then run the bed through, now raise the lever, pull out the bed, lift the tympan and blanket, reverse the plate, and pull through again, now gently warm the plate, and carefully lift away the transfer paper, which should contain the picture with every line firm and sharp, if it is not, sufficient pressure has not been used, or the transfer paper has been made too damp, or sufficient ink has not been put into the lines.

The transfer, either drawn in line, or in chalk, or from a plate being obtained, it is next transferred to a polished litho. stone. Of course the picture can be at once transferred to the zinc which it is intended to etch, but it will be found best, to first of all transfer to stone, then from the stone pull a transfer, and transfer that to the zinc, so that in case of an accident during the etching, another plate can be quickly prepared. Before putting upon the stone, the prepared transfers should be put into a damping book until evenly damp.

Now take a polished litho. stone, and place in front of a fire, or in the sun to get quite dry, place upon bed of press, and adjust the pressure; lay the transfer upon the stone in such a manner that it is put into position without any slurring, place a piece of clean paper upon the transfer, then the blanket; lower the tympan, run in the carriage, lower the lever, and pull through, lift the lever, draw back the carriage, turn the stone round and pull through again, then sponge the back of transfer with water, and pull through again, repeating the damping and pulling through three or four times. Now with a wet sponge satu-

rate the back of transfer with water, and lift away the paper, wash away the composition, leaving the image on the stone, now cover with thick gum solution, and allow to dry.

If more than one transfer is in hand at the time, they are trimmed as closely as possible, and pasted with very thin paste close together upon a large piece of paper, and all transferred at one operation.

The gum upon the stone being dry, wash it off carefully with clean water, then roll up with transfer ink. Clean away any dirt there may be, with sponge, and snake stone : where the snake stone cannot be used, a piece of pointed wood dipped into acid gum will clear away the dirt, taking care to have the wet sponge handy, so as to prevent the acid spreading on to the work ; now roll up as strong as possible, then etch, by passing over water, acidulated with nitric acid of such a strength, that it just slightly effervesces when the stone is touched, saturate a sponge with the weak acidulated water, and go gently over the stone, then with another sponge, charged with clean water, wash off the acid, now again roll up with transfer ink as strong as possible, and pull the transfer. Chalk drawings are transferred to stone in the same way, then etched, but the acid water is allowed to act a little longer than for a line transfer, and after washing away the etching solution, the picture is washed out with clean turpentine, then wiped with a sponge, gummed in, fanned dry, moistened with a wet sponge, superfluous water removed, then the image is rolled up with leather roller charged with transfer ink, and transfers pulled for transferring to zinc for subsequent etching.

To transfer to zinc, take a piece of polished zinc, and clean with pumice powder, immerse in the graining bath (page 32) for about a minute, remove, wash under the

tap, and rub with cotton wool, then wipe dry as possible with cotton wool, warm the plate slightly, lay it upon a litho. stone in the press, lay the transfer (which has been lying in the damping book) upon the zinc plate, lay upon the transfer the backing, lower the tympan, and pull through, then damp the back of transfer, pull through again, then reverse plate, damp back of transfer, and again pull through, again damp back of transfer, and again pull through; now saturate transfer with warm water, peel off the paper, and with a sponge and warm water, remove the composition: now smear over with thick gum, and allow to dry, the plate being now in the same state as those treated by the two previous methods of obtaining the image upon the zinc.

CHAPTER IX.

Etching in Line.

TO etch the image upon the zinc plate into relief, so as to make it fit for printing from, the following appliances are required, viz:—a hot plate, similar to the heater used by copper-plate printers, warmed by means of gas jets underneath; a set of rollers, comprising an ordinary lithographic printing roller, in good condition, a flannel roller, and a glazed roller, an inking slab, an etching tray, 24 inches by 18, by 10 deep, mounted upon rockers, and lined with a good thick coat of pitch, a supply of rags for wiping the slab down, &c., nitric acid, turpentine, gum arabic, three or four sponges, damping rag, powdered resin, a flat camel's hair brush, a solution of shellac in methylated spirits of wine thin litho. varnish, soft and hard etching inks.

The soft etching is compounded as follows :—

Beeswax	...	...	...	6 ounces
Russian Tallow	...	...	...	5 „
Asphaltum	...	...	...	2 „
Litho. Printing Ink at 5/- per lb.				1 lb.

melt altogether in a tin, over a gas stove, stirring well, until all the ingredients are melted and thoroughly mixed, then add 1 lb. of thin litho. varnish, mix thoroughly, and allow to cool, when cool turn the whole out upon an inking slab, and with a stone muller work the whole mass until smooth and homogeneous.

The hard etching ink is composed of :—

Beeswax	...	...	...	...	$\frac{1}{2}$ ounce
Resin	...	...	...	...	$1\frac{1}{2}$ „
Litho. Printing Ink	...	...	...	...	2 „
Shoemakers' Wax	...	...	...	...	$1\frac{1}{2}$ „

melt altogether, stirring well to get thorough incorporation, then cool, and it is ready for use.

A solution of gum arabic is very necessary, a good sample of gum being used, dissolve in water until the thickness of cream, to which must be added two drams of nitric acid to each quart of gum solution, and well stirring after the addition of the acid.

The room in which the etching is to be done must be well lighted, have plenty of benches, and must be provided with a sink and a water tap.

The first stage of etching a zinc plate into relief will be to reinforce the very thin coat of ink, as left upon the bichromated albumen rendered insoluble by the action of light, this operation is called rubbing up, and is done as follows :

first with a clean sponge dipped into the gum solution, smear the front of zinc all over, giving a thin even coat on the gum, allow this to dry spontaneously, or accelerate this drying by means of a pair of bellows, but do not use heat, or the image will split off.

When the gum is dry, the plate is well washed under the tap, and well rubbed with a soft sponge, remove surplus water with a damp rag, and lay upon the bench face up ; cover with gum, and dip a piece of rag into litho. printing ink thinned with turps, (the ink and turps being thoroughly incorporated, else the ink already upon the image will be removed) to about the consistency of cream, rub this inky rag gently, round, and round, all over the plate, until the image stands out black, bold and sharp, do not have too much ink on the rag, and be sure to have plenty of gum on the plate, then the operation of rubbing up will be quickly effected, now wash away the gum under the tap, rubbing gently with cotton wool or lint, dab with a soft damp rag, dry, and cover with powdered resin, brushing with flat camel's hair brush, again wash, then place the plate in a mixture of nitric acid and water, the acid being just strong enough to taste, rock the dish for about half a minute, remove, wash well under the tap, rubbing the zinc back and front with soft sponge, then with damp cloth ; now dry in warm current of air, when dry, put a piece of brown paper upon the hot plate, and the zinc upon this, and allow to remain until the ink just begins to glisten, then remove and allow to cool.

Now examine the image, and if there are any lines defective, touch them up with a fine sable brush, and hard etching ink, thinned with turps, any alteration or addition to the picture must now be made, using the same ink for the purpose.

The back of the plate is now brushed over with a solution of shellac in spirits of wine, and when that is dry, the margin in front is also varnished over, up to about a quarter of an inch of the picture, any very broad whites, which will require cutting out afterwards, are also varnished, so as to economise both acid and time in etching.

The varnish being quite dry, the plate is smeared with gum, and stood away to dry,

Whilst the gum is drying, clean the inking slab, and scrape the roller, then take a little of the soft etching ink, and with the palette knife, put a little ink upon the roller, distributing it in a line from end to end of roller, roll vigorously over the slab until the ink is evenly distributed all over the slab, and upon the roller; the gum on the plate is now moistened with water, using a wet sponge, then it is laid upon the bench, and being well covered with water, it is rolled all over with the etching ink, using moderate pressure, with a slow motion, re-charging the roller at intervals from the slab, and occasionally using the damp sponge, so as to keep the plate sufficiently moist to resist the ink, if the roller slides over the image, wipe it with rag, then re-charge by rolling vigorously over the slab, adding more ink if at all spare.

When the image is well rolled up all over, it is dusted over with powdered resin, which is well brushed in with a flat camel's hair brush, first from one side, then from the other, after which, give a rinse under the tap, a rub with the sponge, so as to remove the powdered resin from the whites, then the plate is ready for the first etch.

The plate is now ready for the first etch, for which purpose a little Nitric Acid is added to the water in the

etching tray—precise directions cannot be given as to how much acid is to be added, as so much depends upon the area of zinc on the plate that requires dissolving; practice, however, will soon enable the operator to judge the proper quantity, if too much acid is added, the plate will quickly be covered with myriads of minute bubbles, in which case it must be instantly removed, well washed, and the bath diluted with water before the plate is re-immersed. If, on the other hand, there is too little acid present, the action is too slow, and more must be added.

The first etch must be carefully watched, and the rocking continued until the application of the finger nail to the margin shows that the zinc inside has been dissolved away to a depth of about the thickness of a visiting card.

The first etching is the most important of the whole, as unless a sufficient depth be attained at the first etch, sharp lines will not be obtained, and as yet, the ink is not capable of resisting too strong acid, great care must be taken that the work is not damaged; proceed cautiously, adding acid from time to time as required.

As a rule, the first etch will take from 4 to 6 minutes (the tray being kept rocking all the time.)

When it is judged that the first etch has been carried far enough, remove the plate from the tray, wash well under the tap, rubbing gently with a sponge, so as to remove the scum left by the acid, dry by means of gentle heat, then put it upon the hot plate until the ink is melted, remove and allow to cool.

When the plate is quite cold, smear it over with gum solution, and with a piece of cardboard or pair of bellows, fan the gum dry.

Sprinkle the inking slab with turpentine, and with a cloth wipe the slab clean. Take a piece of etching ink, and thin with thin varnish, mixing well with the palette knife upon the slab ; now take the leather roller, and with the palette knife place a little of the ink upon it, and roll up on the slab until both roller and slab are well coated, but on no account must there be too much ink, nor must it be too thin.

Lay the zinc down on the bench, and with the wet sponge carefully moisten the gum, then wipe all superfluous water off the plate, and roll up with the leather roller charged as above, roll the plate first one way, and then the other, keeping the zinc evenly damp all over, else the zinc will catch in the whites, and probably spoil the picture. When the rolling is completed, and as much ink as possible been piled on, the zinc will be nearly dry, if not, allow to stand in a cold current for a little time, then take it to the drawer in which the powdered resin is kept, and smear the plate all over with the powder, now brush as much of the resin away as will come, using the brush from all sides, so that all the lines get evenly coated, not only on the top, but upon the sides ; this being done, take a damp sponge and carefully remove the superfluous resin from the whites, or unprotected zinc.

The plate is now ready for the second etch, and the solution in the etching tray must be re-inforced by the addition of a little acid, but do not add too much at once, it will be far best to add a little at a time, and then as soon as the zinc shows there is no action going on, add a little more ; an easy and simple method of ascertaining whether any acid be present or not is to wipe the bare metal with the tip of the finger, and if that spot (which will be brighter than the surrounding parts) does not speedily resume its dingy colour, the acid is exhausted.

The plate being immersed in the solution, set the tray rocking, and paying attention to the remarks above, at the end of ten minutes remove the plate from the tray, wash it under the tap, rubbing gently with soft sponge, then remove as much of the water as possible, and examine the progress made by the acid, which can be seen by lines being bare below the ink, in which case the etch has been carried far enough, and if not stopped, there would be danger of under cutting ; if, however, no progress has been made, add a little acid to the solution, replace the zinc, and rock away for another 5 or 10 minutes.

The second etch being effected, the zinc is carefully washed, and the scum, left by the acid, carefully sponged away ; now stand up near the hot plate, so that it will get the benefit of a gentle heat, and when quite dry, lay it upon the hot plate (which should be heated to a temperature of 120 or 150 degrees F.) face up, with a piece of brown paper between the zinc plate, and the hot plate.

Now as soon as the zinc plate begins to get hot, there will be a tendency to curl slightly away from the hot plate, which, if allowed, would prevent the ink being evenly melted. To prevent this, take a bradawl in each hand, and press down the sides of zinc, taking care not to touch any of the picture.

Allow the zinc to remain on the hot plate, until the ink and resin are melted, and run down to the bottom of the etch, then remove, and lay on the cold slab until the plate is cold.

When cold, smear the plate with the gum solution, fan it dry (*never use heat for drying the gum*), moisten with wet sponge, roll up again (using the leather roller), using the ink pretty stiff on the inking slab, keep the surface of zinc well moistened, and when the roller gets too much water upon it,

pass a piece of damp cheese cloth over it, which will remove the water, then roll the roller vigorously on the slab, until it again bites the ink. Continue rolling the zinc until all portions have received due attention from the roller. *

Now allow the zinc to get dry, then cover with resin, brushing from all sides, so as to coat sides of lines as well as top, and then remove superfluous resin from whites with a damp sponge, and the zinc is ready for the next etch, for which more acid is added to the solution in the etching tray.

Rock the tray carefully, watching the zinc to see that the acid is neither too weak, nor too strong, until the progress can be seen by examining the plate, the time with the proper quantity of acid being 20 to 30 minutes,

When the etching has proceeded far enough, after washing and sponging, again allow to dry, then place upon hot plate until the ink is melted and runs down the sides of lines, then cool, smear with gum, fan dry, moisten with sponge, and roll up as before, dry, cover with resin, using camel hair brush, then damp, sponge, and give a fourth etch, using same precautions as to strength of acid and duration of rocking as before.

The round of operations is repeated, but for rolling up for the fifth and subsequent etch, a flannel roller is used, and more ink will be required upon the slab; it will also require to be a little thinner,

For some subjects, three to six etchings is required, whilst for others—especially where there are whites that are too small for cutting out with fret saw or router—three

*N.B.—Some of the closest work will be quite blocked up this time, and each subsequent rolling will block up more and more, until only the very open work will be left.

etches will be ample ; practise, the best teacher, will soon enable the operator to judge how many, or how few are required.

The etching having been carried as deep as is judged sufficient, warm the plate well, and sprinkle liberally with paraffin, and with a stiff scrubbing brush, loosen the ink from the lines, and wash off with solution of American potash and well scrub with clean water, to remove all traces of potash.

The plate being cleared from all ink, &c., is now examined carefully, the sides of the lines will show each etching, by a series of irregular steps ; and if the plate be put into the press in this condition, the chances are that before many copies had been made, these steps would take more or less ink from the rollers, and blur the image ; therefore, before passing into the hands of the printer, the plate will require etching two or three times more, to get rid of these irregularities.

This is done by warming the zinc on the hot plate, and then, whilst still warm, rolling up with a fine glazed roller, charged with the hard etching ink on a clean inking slab.

Roll firmly, first one way and then the other, so that all the tops of the lines get well coated with ink, make a mark with a blunt point in ink, on margin, so as to lay a short line of zinc bare to the action of the acid.

Now having emptied the etching tray, put it into some clean water, and add sufficient acid to make it taste like strong vinegar, and in this immerse the plate, and keep rocking for ten or fifteen minutes, or until the mark on margin,

when felt with the finger nail, shows that it has attained a depth about the same as obtained in the first etching.

Now warm the plate, and wash off the ink with solution of American potash, and again wash, and dry on hot plate. Now examine, and if the lines are free from the steps, the plate is finished, but if not, the operation must be repeated until the steps are all removed.

Be careful to cover the surface of block thoroughly with the ink, else the acid will soon spoil the picture.

The plate is now ready either for mounting for the press, or for electrotype being taken from ; if the former, the deep whites are cut away with router or fret saw, the edges are trimmed and bevelled, holes drilled and counter sunk at convenient places, for the insertion of nails or screws to fix the zinc to the wooden block, to make the surface type high.

These instructions are applicable for etching into relief, prints on zinc, made either in bitumen or in albumen,

PART II.

PHOTOGRAPHIC ENGRAVING IN
HALF-TONE.

Photo-Engraving in Half-Tone.

INTRODUCTION.

IN making a type block from a photograph, washed drawing, or painting, in which the half-tones are washes of colour, some method of breaking up these half-tones, so as to bring the different gradations of shadows, light and half-tint, upon one plane is necessary, this is usually done by breaking up the lights and half-tints into dots, or stipple, and various are the methods which have been advocated for the purpose.

The first patent, dated 1852, bears the honoured name of Mr. Fox Talbot, is for intaglio printing, and therefore a little out of place under the above heading, still it claims our attention, as giving a method for breaking up the half-tones of the photograph, by placing muslin, crape, etc., between the photographic cliché, and the sensitive surface; or a glass plate may be covered with fine opaque lines, or glass may be coated with fine powder, which is caused to adhere.

In 1854, Paul Pretsch broke up the half-tone by the reticulation of gelatine, caused by the admixture with iodide of silver, and bichromate of potash; this was spread upon a silvered copper plate, dried, and exposed to light under the half-tone negative, then washed in cold water and borax, or carbonate of soda, then in alcohol, then coated with copal varnish, and then in weak solution of tannin, after which, an electrotype block could be made from the relief, or printing ink could be applied, and a transfer made to zinc or stone.

In 1855, A. J. Berchtold produced a grain by printing upon a photograph, in black or in any colour, from a plate or block, or other surface, or by perforating, or making strokes, lines, or dots upon it, by roller or other instrument, worked by machinery or by hand, such perforations passing completely, or only partly through the picture, which methods of producing a grain have been re-patented in 1883, by Brown, Barnes, and Bell.

In 1860, E. J. Asser used starch, and in 1865, J. W. Swan, a tissue of gelatine mixed with charcoal, or other chemically inert grit, and in the same year Messrs. E. & J. Bullock published, perhaps the most important specification, describing all, or nearly all practical methods of obtaining grain, the most important of which are, the placing of any fine fabric between lens, and sensitive surface, or between camera and object, or copies of granulated, or reticulated structures or fabrics could be used, or such copy could be placed in contact with negatives, and both copied together.

In 1879, J. W. Swan made negatives, by moving, during exposure, the Bullocks' screen, placed in front of sensitive plate and Meisenbach's specification a little later, is somewhat similar.

Woodbury reliefs can be used for the production of Photo-type blocks in a very simple manner, but there is nearly always a halo round the outlines, which spoils the effect.

If a Woodbury relief is thinly coated with transfer ink, and then laid upon a piece of ordinary litho. transfer paper, which has been embossed with lines, or dots, or stipple, by being pressed in contact with the wire gauze, or an engraved plate.

The inked relief, and the embossed litho. transfer paper, are then subjected to heavy pressure, and a grained image is impressed upon the transfer paper, from which it can be transferred to zinc, and then etched in relief.

The method now in general use, and which will be fully described in this book, shortly stated is as follows—a copper or steel plate (preferably) is ruled by special machine, with fine lines diagonally across, from this plate an impression is printed upon smooth white paper, this sheet is photographed, two exposures being made, turning the sensitive plate end for end between the two exposures, the result being a negative with crossed lines, and called a screen, this screen is placed in front of sensitive plate, and the photograph or picture to be re-produced as a type block is copied through this screen, the dots upon which, obstructing the light, cause the half-tones to be broken up, and render it available for typographic printing.

From the grained negative a print is made on zinc or copper, in bichromated albumen or bitumen (preferred) the dots in negative protecting the sensitive surface from the action of the light, the surface of zinc is left free from resist, consequently the mordant eats away the metal, and so forms the relief block.

When the etching fluid has done its work, the whole of the resist is cleaned off, and a proof taken, the result being far from perfect, in consequence of the general flatness of the image, but after the plate has been re-bitten two or three times by an artist, who, by stopping out various portions of the picture, and re-etching, gradually infuses brightness into the lights and half-tones, and produces a result, which, properly manipulated on the printing press, puts into the shade all manual engravings, for truth and finish.

For photo-engraving in half-tone, the same apparatus and methods of making the negatives, &c., are used as have been described in detail in the earlier chapters of this book.

The wet collodion process, or the special dry plate method may be used just as is most convenient to the operator, but if the dry plate process be employed, *it must be again most emphatically laid down, that only the special dry plates mentioned, be used, the ordinary dry plates of commerce being utterly and entirely useless for the purpose.*

Beginners are also cautioned against any deviation from the method of working given, until by practise they have mastered their process, and are thus in a position to trace out any failure.

CHAPTER I.

The Screen.

THE screen is a negative taken from an impression from a steel or copper-plate machine, ruled with lines 120 to the inch, the plate being at least 18 inches square, the lines being ruled diagonally, one way only.

The impressions from these plates must be absolutely perfect, on smooth white paper, and in jet black or brown ink; a perfect sheet with care, should last a life time, and as they cannot be prepared in a hurry, too much care cannot be exercised in their storage.

The sheet should be mounted upon thick smooth card board, freshly made; starch, or well stained gum being the best mountants for the purpose, the fine lines on the sheet being very difficult to focus, especially when making very small screens; it is advisable to paste narrow strips of bold type at each corner, just outside the ruling, and focus these. To make the screens, remove the mirror and its box, placing

the lens in the camera, in its ordinary position, fix the ruled sheet upon the easel, and after ascertaining that the camera and easel are quite parallel, carefully focus, getting the image absolutely sharp all over, using a focussing magnifier carefully adjusted to the operator's sight.

If the focussing screen be at all rough, this will be a matter of some difficulty, unless the ground surface is greased, the grease being removed with a rag as close as possible.

A series of screens should be made, varying from 4 to 10 inches in width, also of different degrees of density, so as to suit the different grades of photographs for reproduction.

The lines upon the sheet are not crossed, so to get the lines crossed in the screen negative, two exposures are made, the sensitive plate being returned to the dark room, and turned end for end between the two exposures, some screens should be made of the single ruling only, and will be found very useful for many subjects.

Each screen must be free from speck or stain, or they will be quite useless, the lines represented by bare glass, and absolutely sharp. These screens may be made either by the wet collodion process, or upon the special photo-mechanical dry plates, which, together with the dark slides, must be carefully dusted before use, do not over expose, nor hurry in development.

When the wet collodion process is used, the nitrate of silver bath must be in its very best condition and full strength, the collodion ripe, well settled, and carefully decanted ; the glass plates should be of very thin patent plate, free from specks, or flaws, carefully cleaned and albumenized, drying rapidly in a warm room, free from dust.

These screens require great care in their preparation, but as they must be perfect, and are the foundation of the process, the time and trouble taken in making them must not be grudged ; with care a good screen will last for years.

The final operation of screen making is to coat them, whether on wet plates or dry, with a good film of white hard varnish well filtered.

CHAPTER II.

The Grained Negative.

HAVING made the screens in various sizes and degrees of density, lines clear and sharp, the next step to consider will be the grained negative.

Grained negatives for half-tone blocks should not be made from the original subject, a far better effect being obtained from a good silver print, preferably upon plain paper ; if any of the outlines or details are obscure, by judicious re-touching upon the print, a more satisfactory result will be obtained, heavy shadows being relieved by washes of blue, or white pigment.

A print for reproduction should be flat, rather than brilliant, as tending to the better rendering of the half-tints. The screen used must be chosen to suit the subject, both as regards fineness and density ; the finer the detail in the print and the smaller the block (due regard being paid to the fact whether the printing is to be done upon rough or fine paper), the finer the screen ; a dense screen being used for a bright print, and a more transparent one for a flatter subject.

The screen being placed in front of the sensitive plate during exposure in the camera, some arrangement must be made to ensure the sensitive plate being in focus.

When the dark slide will admit of it, the screen may be fixed in front of the plate carrier by means of thin strips of cardboard or metal, the wire corners of carrier keeping the two films apart, an essential necessity when the wet collodion process is used ; if the dark slide has not sufficient room between the front of carrier and sliding shutter, then the screen must be laid in the carrier, the collodion film being prevented from contact by means of two or three thicknesses of clean blotting paper at each corner, the focussing screen being packed out in its frame to the thickness of the screen and the blotting paper.

With dry plates, the two films (carefully freed from dust) may be in contact, so that the packing out of the focussing screen, need only be to the extent of the thickness of the screen.

The above preliminaries being attended to, the print to be copied is fixed upon the easel, the mirror put into its box, the lens screwed into the flange, and the camera adjusted, till the image upon the ground glass is of the size required, a negative can then be made either by the wet collodion or dry plate process, the manipulations given in the earlier chapters being the same except in the wet collodion, when the negative is finished after washing from fixing with cyanide of potassium, grained negatives not requiring the after operation of intensifying.

A grained half tone negative must be perfectly clear all through, free from spots, or stain, or fog.

Instead of using a paper print, from which to make the grained negative, a transparency may be used, the screen being in contact either with the film of transparency, or of sensitive plate.

Using a transparency from a perfect negative will, in skilled hands, and a good light, yield by far the best results, especially when the screen is in contact therewith; but in very dull weather, the small stop necessary to get absolute sharpness from corner to corner, makes so long an exposure necessary, that this method is at a great disadvantage, as compared with the screen next the plate, in which case a large stop may be used, materially shortening the exposure, the image not requiring the same microscopic sharpness necessary for the grain.

CHAPTER III.

HALF-TONE PRINTING ON ZINC.

A suitable grained negative being obtained, the next operation will be to make a print from it upon zinc in bitumen.

For the operations, of printing upon zinc in bitumen and the subsequent etching into relief, the same apparatus, rollers, and materials, as are described in Part I, are used.

The zinc plates used for half-tone blocks must be the very best procurable, as near flat as possible, the best gauge being 17 or 18.

The zinc plate as received is first of all polished with charcoal, the sticks being cut at an angle, and kept in water when not in use.

The polishing is done by rubbing the charcoal in short circles round and round, the plate being kept flooded with water all the time, until the whole surface is perfectly smooth

and quite free from scratches; when this result has been attained, wipe dry with a clean dry cloth, and finish the plate with a paste of whiting, moistened with spirits of wine and ammonia, or of benzole and vegetable naphtha, rubbing the paste on with a piece of clean lint and polishing off with another piece.

Too much care cannot be taken in these operations of polishing and cleaning the zinc, as upon these being properly performed depends in a great measure the quality of the block, scratches being quite fatal.

If the plate is scratched, defying the power of the charcoal to remove, a preliminary polish with fine emery cloth, and turpentine will be requisite, the emery cloth being stretched over a cork rubber, or over a block of wood, 4 + 3 + 2 inches covered with thick felt, the zinc being placed upon a board covered with American cloth, the face sprinkled with turpentine and then rubbed with the emery cloth (to and fro only, not round and round) until the turpentine has evaporated, if the scratches are removed the plate is ready for polishing, if not, the emery cloth must be used until they are.

The sensitive film with which the zinc is coated is of prepared bitumen, as described in Chapter VII, Part I., dissolved in pure benzole, the polished and cleaned zinc plate being put into the whirler, carefully dusted with a camel's hair brush, then sufficient of a carefully filtered solution of prepared bitumen in benzole is poured upon the plate, the whirler being promptly reversed and set in rapid motion for about one minute, when the film will be found quite dry, and if perfectly even and free from dust spots, is ready for the printing frame. Spots are caused by careless filtering,

and by neglecting to dust the plate before pouring on the bitumen solution. In filtering the solution of bitumen, precautions must be taken to prevent evaporation of the benzole, which is very volatile, the best medium for filtering being two thicknesses of good lint.

The benzole used for dissolving the bitumen must be pure and quite free from water; if any difficulty be experienced in procuring good benzole, a preparation called "Benzine Collas" may be used, but it is far more costly than pure benzole; methylated chloroform is also a good solvent of the prepared bitumen, but being so much more volatile than even benzole, it requires some skill to use, the thickness of the bitumen being so uncertain from one time of using to another. When methylated chloroform is used, the whirler cannot so well be used; so the best way of coating is to let the bitumen solution run over the plate from the filter, putting on a good pool, at once throwing off the superfluous into the funnel, and draining off quickly, the film drying almost instantly.

The film of bitumen must be very thin, just sufficient to give a pale golden hue to the zinc.

The zinc plate coated with the sensitive bitumen is put into the printing frame in contact with the grained negative, and screwed up as tight as possible, (as unless the negative and zinc be in perfect contact, the print will be quite useless), then exposed to light.

The exposure must be made to sunlight when possible, and will require from one to three hours, the exact time of course being a matter for experiment and practice; when diffused light only can be had, then the exposure will be very uncertain, and two or three trial zincs should be put out at the same time as the main zinc, the trial zincs being

withdrawn and developed at intervals before the main zinc.

All photographic exposures are very difficult to lay down on paper, so much depending upon many conflicting circumstances which may be prevailing at the time, practise and careful observation being the only true guides ; a standard negative, of which, by being frequently printed in sunlight and diffused light, the time of exposure is known, should be kept, and in time, the operator can, by comparison with each fresh negative, accurately (or at least approximately), apportion the requisite time of exposure.

When the exposure is judged to be sufficient, the zinc is withdrawn from the frame, immersed in dish containing turpentine, and gently rocked until the bitumen, not rendered insoluble by the action of light, gradually comes away, leaving the image upon the zinc, which is at once withdrawn, and well washed under a tap, then placed between clean sheets of blotting paper to remove the water. A bath of water and nitric acid is now prepared, the acid being just strong enough to taste, in which the zinc plate is immersed ; the acid attacking the bare zinc dulls the bright lustre, and allows the operator to at once see if all the bitumen has been removed from each dot or stipple ; as if not, the plate must be well washed back and front (*not rubbed*), blotted off, and at once returned to the turpentine, there to remain until the last vestige of bitumen is removed from the whites.

If after immersion in the acid bath (one minute being sufficient) the image shows clear and bright, it is well washed, the water blotted off, and put away to dry.

The developement of the bitumen image in the turpentine is not a very rapid process, except when the exposure has been just right, in which case the plate must be carefully watched and removed as soon as developement is

complete; if the exposure has been longer than necessary, a prolonged immersion in the turpentine will be all that is required to get a good plate, as within certain limits there is a large degree of latitude permissible in the exposure of sensitive bitumen, so long as that exposure has been sufficient.

When methylated chloroform is used as the solvent for the sensitive bitumen, the developement is much more rapid, indeed it is often done by a mere wash over with turpentine, and the image is cleared at once, so that when chloroform is used the developement must be very closely watched.

As is hinted above, over exposure is not very much to be feared, but under exposure will soon declare itself by the image breaking up, either in the grain, or image, in which case it is useless proceeding further with it, the plate being wiped clean, polished with whiting and spirits, and re-coated with bitumen.

The plate after immersion in the weak acid bath, must be a perfect replica of the negative, every line or dot showing perfect, the dark half-tones of picture also being clear and free from deposit of bitumen; the net work of grain across the lights, and light half-tones, being quite perfect and free from break, then the plate is ready for the etching.

CHAPTER IV.

ETCHING HALFTONE PRINTS UPON ZINC.

BEFORE proceeding with the etching, the border lines are first made. When a thin white line is next the picture, this line is scratched with a graver, using a steel straight edge for a guide; a black line of stopping out varnish (composed of hard etching ink thinned with turpentine) is then care-

fully painted upon the zinc outside the scratched line ; another line being afterwards grooved out, leaving the thickness of black just as required for the finished line. This last line may be grooved out nearly through the zinc, and then painted over with stopping out varnish, as also the back of plate.

The plate is now ready for the first etching bath, the strength of which may be tested by placing a little upon a piece of clean litho stone, which it should just cause to effervesce, the etching bath being water and nitric acid ; the plate is immersed, and gently rocked for two or three minutes, being closely watched the whole time, so that it may be removed, at the slightest evidence of undercutting.

When it is judged that the biting has progressed far enough, the plate is removed, washed well, the water blotted off, and the image fanned dry ; it is then smeared over with gum and allowed to dry. When dry, moisten the gum with a damp sponge, and roll up with litho printing ink, thinned with thin litho varnish, using a good grain leather litho roller, continuing the rolling until the whole of bitumen forming the image is completely covered with ink, taking care to keep the zinc well moistened by the frequent application of a damp sponge.

When the whole of the bitumen is covered with ink, fan dry, then dust over with very finely powdered asphaltum, brush the powder well in with a camel's hair brush, wash off the surplus asphaltum, dab dry with a soft cloth, then warm on the hot plate until the asphaltum and ink are just melted ; remove, cool, and after making a slight scratch in margin, immerse in acid bath, which must be a little stronger in acid than before, testing by means of the effervescence of litho stone.

The second etch will take about ten minutes, the etching tray being kept gently rocked all the time, the solution being from time to time poured over it from a height, using a cup for the purpose, so that the scale may be washed away, and the fact of the presence, or otherwise of sufficient acid determined, as when the solution is poured upon the plate, the metal shows bright, which brightness should, if the acid be sufficiently strong, quickly disappear, but if not, the action is too slow, and the time given above will be too short.

During the time the plate is in this bath, it must be very closely watched, and removed at the slightest sign of undercutting, or if any of the grain should be attacked, which however is not likely, so long as the acid is not too strong. The second etch will have proceeded far enough as soon as the scratch in margin gives a grip to the finger nail, when the plate is removed, washed under the tap, and the whole of the resist, bitumen and all, removed with turpentine and a small stiff brush, again well washed, and wiped quite dry.

The plate as done so far will print, but the result will be very flat and grey, so that to finish it, it will be necessary to re-bite, this re-biting being carried on until the high lights have their true value, and the whole picture stands out bold and vigorous, instead of flat and grey.

This re-biting is properly the work of an artist, and can only be done successfully by some one who has some slight skill in the use of the brush.

CHAPTER V.

Re-biting Half-Tone Zinc Blocks.

FROM the block, as left in the last chapter, a proof should be pulled on an ordinary printing press, the pull to be the guide in the re-biting operations, now to be effected.

The inking slab must first of all be cleaned down with turpentine and an old rag, a piece of hard etching ink (Chapter IX., Part I.) is taken from the tin and mixed with turpentine until about the consistency of soft soap, using for the purpose a palette knife; the glazed roller is cleaned with turpentine and rag, then charged with the ink, rolling it upon the slab until a fine even coat of ink is obtained, the rolling being continued until the turpentine has evaporated, leaving the ink on roller and slab dry and hard.

The etched block is warmed on the hot plate until of blood heat, when it is removed, sprinkled with turpentine and well scrubbed with a stiff brush, the operation being repeated until the whole of the ink is removed from the metal, replaced upon hot plate, a piece of clean paper being underneath it; and when again about blood heat, roll up with the charged glazed roller, rolling gently and carefully until all the image is covered with the ink, remove the zinc from the hot plate to the bench, and continue the rolling until the ink has set quite hard and dry to the touch; examine the picture, and if the tops of the lines only have been inked up, the plate is all right; but if the ink has

run down into any of the portions etched away, the plate must be warmed up again, the ink removed with turpentine and stiff brush, the rolling up being repeated. Novices will find a great help in this operation if they first fill up the etched lines of plate with whiting, afterwards wiping all whiting from the surface, and polishing up the block with the palm of the hand, the whiting being washed away, and the plate dried after the inking up is done, and before proceeding further.

The zinc being properly inked up, it is laid upon the bench in a good light, the print from it being placed close to it; the etcher will then proceed to paint over all those portions of the picture which are sufficiently dark enough, leaving those open only which it is deemed necessary to have lighter printed; a good sable brush (or brushes) must be used, the stopping out being done with the hard etching ink.

When the stopping has been done, carefully softening any harsh outlines to such stopping out so that the effect from half-tone to light is gradual instead of abrupt, the plate is ready for the etching bath, the acid in which is kept weak, as before, a fresh bath being used each time, so that the full effect of the acid is got, as cannot be the case if the acid bath has been previously used. Rock the dish gently, and watch very closely for about three minutes; then remove, wash, dry, and remove the whole of the resist with turpentine and stiff brush, wipe clean and pull another proof, from which can be seen the improvement made, and also the further improvement that can be effected, far better than any further instructions.

This rebiting is a very important portion of the process of making these zinc blocks, and has no doubt given rise to

the theory of a discriminating grain put forward by some writers, who, not being practically acquainted with the work, have sought to build up an edifice of theory to hide the fact.

One of the best specimens of this rebiting, which, whilst being perfectly effective, still to the eye of the expert shows the method quite plainly, is a block on the front page of the *Illustrated London News* for November 8, 1889, of Tippoo Tib; the background and turban, in which has been re-bitten, making as fine a portrait block as has ever been published.

From the above it will be seen that the process of making halftone type blocks is not a very simple one, but requires skill, care, and patience at each and every stage; nothing must be hurried, nothing slurred, every operation must be done with intelligence and method; the instructions given are as full as is possible upon paper, but there are lots of little dodges which may be used, and which any student will find himself practising, which are not, and cannot be, mentioned here, because, although these dodges come up as wanted, the deepest thinker cannot remember them afterwards; the memory of them vanishes as soon as the necessity for their use has gone, to reappear as mysteriously when next required.

Very fine halftone blocks should be made upon copper instead of zinc, the whole of the operations being precisely the same, but the best mordant to use is that commonly called the Dutch mordant, composed of

Fuming Muriatic Acid (spg. 1, 190) ...	10 parts.
Water	70 „
Add a boiling solution of Chlorate	
Potash	2 „
Water	20 „

This being diluted with 300 parts of water for use.

TRIMMING AND MOUNTING THE ETCHED ZINC.

When a large amount of work is turned out, a circular saw is required to cut off the edges and trim up the zinc previous to mounting; if only a block be done now and then, a small hand saw will do the work.

When the edges are cut off, a good file must be used to get rid of the burr left by the saw.

To mount a zinc type high, bay wood is usually used, being procured in slabs, planed both sides, and about three quarters of an inch thick, which, with the zinc plate (guage 17 or 18), will make the combined height as near as possible type high, any difference being below, which is better than being too high; a rough and ready method of ascertaining whether the block is near right may be done by measuring with a shilling, the diameter of which is about the height of type; if zinc of a lower guage be used, then the bay wood blocks must be thinner.

A block of wood being cut to size and squared with a shooting plane, the zinc is bored in any suitable place, the etched out portions representing the whites of print, being usually selected close to the edges, as well as in centre, using a small hand drill for the purpose; the zinc is then fastened to the block with small wire nails, well punched home; when the block contains any very broad whites likely to catch the inking rollers, the metal should be cut out with a chisel after mounting, the wood being also gouged out to give additional depth.

Half-tone blocks are a little more difficult to mount, there being only the edges of zinc available, but if the

edges after trimming are bevilled outwards with the file, there will be sufficient room to drill holes on the skew, which will efficiently fix the metal to the block.

CHAPTER VI.

Other Methods of Making Type Blocks.

SWELLED GELATINE PROCESS OF MAKING RELIEF BLOCKS.

By this method, type blocks are made without etching, the block being obtained from a wax mould, by the process of electrotyping, the wax mould being made from a cast in Plaster of Paris, from a bichromated gelatine film exposed to light under a negative, then soaked in cold water, until those portions representing the whites of original, have absorbed water and swollen, the lines not swelling, on account of the light having deprived them of the power of absorbing water.

As in the etching methods, the first consideration is a suitable negative, in which the lines or original drawing, are perfectly sharp, free from fog, or veil, the whites being represented by perfect opacity. The gelatine films are prepared as follows:—Four ounces of Nelson's amber gelatine are soaked all night in 15 ounces of water, then melted in a suitable vessel, a gas or paraffin stove being preferable to an open coal fire, one ounce of sugar, and ten drops of a saturated solution of chrome alum, are then added, stir well until dissolved, strain through muslin, and it is ready for coating the plates, which are first carefully cleaned, then coated with plain enamel collodion and allowed to dry; coat

with the gelatine solution, in the proportion of three ounces to a plate 12 by 10; when coated, put the plate upon a level slab until the film of gelatine has set quite firm, then place on a rack to dry in a current of dry air; when dry, the plates may be kept indefinitely. When required for use, the films are sensitized by immersion in solution of:—

Bichromate of Potash	...	...	1 ounce.
Water	..	...	15 „
Methylated Spirits	...	...	5 „

Three minutes immersion are sufficient, this time the plates must be dried in the dark room.

When dry, expose under negative until the image shows through to the back, remove from the frame and immerse in clean cold water, where it must remain until the whites have absorbed all the water possible. Just how long soaking is requisite will be a matter for practice; if not soaked sufficient, the relief will be too low; if too long, the tops of the lines will be rounded instead of flat; this, however, would take 12 to 15 hours. On an average from two to four hours will be sufficient; when sufficiently soaked remove from the water, dab with a soft rag until surface dry, and lay upon the bench ready for the plaster.

The plaster is prepared by pouring sufficient fine plaster of Paris into a basin half full of clean water, stir until thoroughly mixed, then pour upon the gelatine film, rub gently with the finger over the film, so as to break and disperse any air bells, sufficient plaster should be mixed to make a cast at least half an inch thick, the back being levelled with a palette knife; the plaster must not be mixed too stiff, or it will set before it has time to get down into the lines, and if too thin it will refuse to harden.

When the plaster has set hard and dry, turn it over, trim off the edges with a knife and gently force the plate away from the cast, which should show the picture clean and sharp and quite free from broken plaster.

To make the wax mould, the plaster cast is placed in a deep porcelain dish, and water poured in until nearly level with the top; the plaster will absorb water, and as soon as it shows evenly moist all over the surface, remove from the water and pour over it melted wax mixed with fine black lead, and when set lift away from the plaster cast, trim and bevel the edges; then proceed to build up the whites with wax guiding the wax with conical tool heated, a stick of wax being pressed against the hot tool; the melted wax runs down the tool, and is readily guided just were wanted; when finished the mould is ready for electrotyping, a process quite outside the scope of this book, and with which the writer has only a theroretical knowledge.

For half-tone blocks the gelatine films are sensitised in—

Bichromate of Potash	...	...	1 ounce.
Water	...	...	15 ounces.
Ferricyanide of Potash	...	...	240 grains.

Immerse for three minutes, then dry at a temperature of 120 degrees fahrenheit; expose under an ordinary half-tone negative (rather thin) soaked in cold water until thoroughly swollen, immerse in a bath of tannic acid one ounce, methylated spirits 20 ounces, soak for five minutes, then dab surface dry, then make the plaster cast, from this the wax mould, and finally electrotype, no building up of whites is required with half-tone blocks.

This method of producing phototype blocks is very interesting as a process, but is of a very limited practical use, in fact nothing can be done by it, that cannot be done cheaper, better and quicker by the etching method ; for half-tone blocks, it is quite useless, as there is no power of compensating for the degradation of the whites caused by the screen, as there is by stopping out, and rebiting, in the etching method.

WASH-OUT GELATINE PROCESS.

In the swelled gelatine process it is necessary to use a gelatine of the very best quality, so that the unexposed portion of the film may absorb the maximum quantity of water, and so enhance the height of the relief, but in the wash-out process we require to use a very poor quality of gelatine, so that the setting power be easily destroyed by prolonged boiling with ammonia and sodium carbonate or hydrochloric acid. The process is as follows :—Three pounds of glue are soaked in cold water until thoroughly soft, the water being changed at frequent intervals, so as to remove any soluble impurities, when quite soft, drain free from water and put into a jar, place this in a pan of water, and put on a slow fire, gradually raising the temperature to 200 deg. far., when the glue is melted add five ounces of ammonia or one ounce of hydrochloric acid, then keep up the temperature of 200 degrees for three days or a week, until the setting power of the glue is quite destroyed, when this stage has been reached, add five ounces of treacle, ten ounces of water, three ounces of bichromate of potassium in fine powder, mix thoroughly, then strain through muslin, when it will be ready to coat the plates prepared as below, clean glass plates of a sufficient size with dilute nitric acid, rubbing and washing well the coat with—

Gelatine	...	...	...	2 ounces.
Water	...	...	...	20 „
Bichromate of Potassium	...	...	...	30 grains.

melted and flooded over the wet plate, when coated stand up to dry on a rack, and when dry expose for an hour or two to strong light, so as to make thin film of gelatine thoroughly insoluble, now place these plates on the levelling screws of a drying box which can be heated to 80 or 90 deg. far., coat with the sensitive glue mixture, putting on as much as possible without overflowing, and when all in the box are coated, close the lid, and the films will be dry in from three to six hours, be very careful of dust or air-bells as they would quite spoil the surface; when the plates are dry expose under the negative, which must be quite opaque in the black portions representing the whites in the original and clear in the lines, the progress of the exposure can be seen from the back, but with practice a time exposure can be given, from five to thirty minutes in sunlight being required; the longer the time, the deeper the relief. When the exposure is complete, lay the plate in a dish of cold water for ten minutes, then put it into an upright bath containing water at 100 deg. far., when the development will be complete in from two to six hours; remove, wash under tap and immerse for fifteen minutes in a strong solution of alum, wash, remove surplus water, by dabbing with a soft rag and at once pour over it plaster of paris, using the very best and not at all thick, allow the plaster a couple of hours to set, then lift the plate away carrying the gelatine image, after the plaster is poured the back should be smoothed as much as possible, from this cast, polished with plumbago, an electrotype is made. If the film of gelatine be dried upon a metal plate instead of glass, instead of taking a cast, the plate can be mounted upon wood, and printed from in the press.

PART III.



PHOTO-LITHOGRAPHY IN LINE.

CHAPTER I.

Photo-Lithography in Line.

PHOTO-TRANSFERS have been made and used for many years, but it is only very recently that the great advantage of a photo transfer, from the original drawing, over a drawing put down direct, has been generally recognised.

The majority of the best artists cannot make a good drawing, which will look as well on the stone as it does before transfer, one reason being that the prepared transfer paper used is not so good to draw upon as a good drawing paper; then again, it is not always possible to make a good drawing within exact limits, or with lines as fine and sharp, as are looked upon as a *sine qua non* in lithographic work of the present day; good drawings made upon white paper, larger than the litho is required, may be photographed, and a photo transfer supplied, which will be far superior to a direct drawing upon stone, or transfer paper, having all the sharpness of an engraving on the stone.

For colour work, where one design has to be produced in a variety of sizes, photography renders material aid, a pull in black from each colour stone, being photographed, and transfers made the required size, so obtaining a whole series in different sizes without the uncertainty and expense of having to re-draw the whole series.

Whether the drawing is in line, dot, stipple, or chalk, is quite an indifferent item, all being reproduced with equal facility ; for the production of a photo transfer there are two methods, the rigid and the flexible, the rigid method being a direct photo print upon zinc, from which prints may be made direct, or the zinc plate may be used as an original, re-transfers being taken as required.

When the photo transfers are made upon zinc, a reversed negative of the drawing will be required, and the transfer printed, either in albumen or bitumen (Chapters V., VI. and VII., Part I.), the operations of pulling the transfer being then purely lithographic ; for lithographic transfers, say of map work, where it is absolutely necessary to work to exact size and scale, printing the transfer upon zinc is the only plan ; the flexible method not being capable of rigid exactness, as, in the manipulations the paper transfer has to undergo, the paper stretches, and contracts, and scarcely two different samples of paper stretch and contract alike ; for printing the photo transfer upon zinc, the thick metal used for type blocks is not necessary, thin plates being far better ; the zinc may be either smooth, or polished, or the prepared plates, sold as substitutes for litho stones may be used.

Flexible paper photo transfers are made upon paper coated with gelatine, the resulting transfer being very little different from the ordinary lithographic transfers.

For these transfers the photographic negative is taken direct, *i.e.*, without a mirror, and must be perfectly sharp from corner to corner, the lines forming the image being represented by apparently clear glass, without fog, or veil, or stain, the whites of the original being as near opaque as possible.

These negatives may be either by the wet collodion process, or upon the special gelatine dry plates, (as treated of in Chapters II., III. and IV., Part I.) ; the remarks in Chapter I. about apparatus, dark rooms, &c., also apply to photo lithography, cheap apparatus sold for outdoor work being useless for this purpose.

For exposing the paper to light under the negative, strong printing frames, with thick plate glass fronts, stout backs, good clean soft padding, either felt, or blotting paper, and screw pressure, are required, so as to get absolute contact between negative and paper during exposure ; it is false economy to have thin plate glass in front of these frames, as it is so easily broken ; a sudden change of temperature, such as takes place in carrying the frame inside the room after exposure outside, being a frequent cause of breakage.

For inking up these transfers, the same rollers of glue and treacle, as used in typographic printing, photo transfer ink, palette knife and inking slab, (described in Chapters V. and VI., Part I.), are required, with the addition of a board to hold the transfer in situ during the operation ; the board is here illustrated, and is made in two parts, hinged together, the hinges being counter sunk, so that the board can lie flat upon the bench ; at the extreme end of the smaller piece of wood a thin strip is nailed, that when the print is clipped, the board only touches the bench at the extreme ends, so that the pressure of the roller causes the paper to be held quite tight ; instead of having the edges of the two boards square, as in block, they are better rabbeted, when the grip is much stronger ; this board should have two or three coats of good hard white varnish, then when inked it can be cleaned with turpentine.

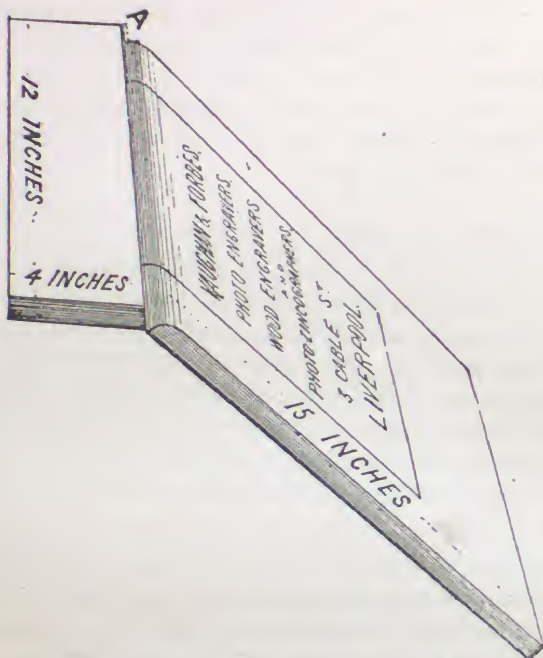


FIG. 3.

Two zinc trays, 24 by 20 by 4, will be required for sensitizing the paper in, and subsequent soaking, prior to development, also some good surgical lint, blotting paper, and a drying closet, heated to about 70 or 80 degrees F. for drying the sensitive paper in.

When transfers are required larger than the largest plate capable of being exposed in the camera possessed by the reader, two, three, four, or more negatives may be made, each negative containing a different portion of the original, with of course a little overlap for piecing purposes, but when a job of this description is undertaken, once the camera is

focussed for the first negative, it must not be moved until the whole series of negatives have been made, the drawing being adjusted in position on the easel to marks made previously, of course to make a success of this class of work the apparatus, camera, and easel, must be solid, strong, and true, or the result cannot be a success.

In making transfers in sections, for subsequent piecing together, either before transferring, or after printing, great care must be taken to cut the paper all the same way of the sheet before exposing to light under the negative, as all paper stretches more one way than it does another; it is obvious that it will be a difficult, if not impossible task, to match two sections, one cut the long way of the sheet and the other the narrow; the same remarks being pertinent to transfers for colour stones, and must be rigidly adhered to, when the transfers are all small, cutting all out of one sheet will much facilitate "register" in printing.

Apropos of this, the following measurements of a sheet of Photo-litho paper are interesting, and will show at once the importance of the above remarks.

Dry as received 23 1-16 by 17½

Dry after sensitizing. and drying

at 80 degrees F. 23 by 17 5-16.

The transfer blotted, and ready

for drying 23½ by 17 11-16.

Transfer dried at 60 degrees

F. 22 15-16 by 17 3-16.

After being in damping book 23 1-8 by 17 5-16.

The transferring to stone of photo-litho transfers, differs very little from ordinary transfers, the sojourn in the damping book should not be longer than just necessary to get the requisite grip, the stone must be evenly warm, pull

through the press steadily at least twice, before lifting the tympan, damp the back thoroughly, then after two more pulls thorough, the paper must be lifted away, leaving all the ink upon the stone.

As a general rule it will be better to buy transfer ink ready made, but here is a receipe for making it when so preferred :—

Chalk Printing Ink Litho	4 ounces.
Beeswax	$\frac{1}{2}$ ounce.
Stearine	$\frac{1}{2}$ ounce.
Resin	$\frac{1}{2}$ ounce.

Melt the resin first, then add the wax, when melted, add the stearine, then the ink a little at a time, stirring well till all is melted ; the mixture may be made in a tin, on a bunsen burner or stove.

Instead of using stearine, mutton fat may be used, obtained by dropping solid kidney suet (mutton) into a pan of boiling water, when cold the fat will be on top of the water in a solid cake, and requires laying upon a sheet of blotting paper to get rid of water hanging to it, then it may be weighed.

CHAPTER II.

PHOTO-LITHO TRANSFERS are printed upon paper, coated first with gelatine, then with albumen, afterwards sensitised in a solution of bichromate of potash. Full directions will be given for the preparation of this paper from beginning to end, but first of all, it is intended to give instructions how to work a paper that can be purchased ready prepared, only requiring sensitising to be ready for use. This paper is manufactured by Professor Husnik, and

is sold by Winstone. By using this paper, beginners avoid the risks of failure from unevenly coated paper, and from the numerous causes of trouble only encountered by tyros; they also obtain a better idea as to what they have to aim at.

The paper as received must be kept quite dry and away from foul air; it is sensitised for use in a solution made as follows:

Bichromate of Potash	...	...	1 ounce.
Water	...	...	16 ounces.
Methylated Spirits of Wine	...	...	5 ounces.

When the Bichromate is dissolved, add Liquor Ammonia until the colour of the solution is changed from red to a light yellow; be careful not to add a large excess of Ammonia after the colour has undergone the change indicated.

This solution is poured into a dish, and the paper is drawn slowly through, face up, so as to avoid scraping the bottom of dish; the paper must not be allowed to remain in the solution, but simply drawn slowly through, then it is hung up at once to dry in a cupboard capable of being heated to a temperature of 80 degrees F.; this may be done by having a sheet iron bottom to the cupboard, under which is a gas jet or a paraffin lamp, the bottom being flanged downwards to the extent of six inches, and a pipe in the flange close to the bottom of cupboard to carry off the fumes from the products of combustion, which must not be allowed to get access to the interior of cupboard.

The dimensions of the cupboard should be 30 inches high by 22 inches deep, and 12 or 15 inches wide; then full sheets of paper can be dried in it.

The paper when wet is pinned upon rods fitting into slots 2 inches from the top; the top of box should have a few augur holes in the top for ventilation.

The room in which the operations of sensitising, drying, inking up, &c., are conducted, must have the window covered with one thickness of golden fabric, or of a good yellow printing paper, or must be lighted by gas or paraffin ; the transfer paper, though extremely sensitive to daylight, is not affected by artificial light of the low actinic power of gas, or paraffin light.

When the paper is dry, it should be rolled up and put in a tin case, or in a portfolio interleaved with dry blotting paper, and only sufficient for the day's use should be sensitised at a time, as it does not keep well in that state.

Before putting into the printing frame in contact with the negative, it should be pulled through the press upon a clean dry litho stone, or through a pair of rollers between two smooth shalloon boards, so as to smooth it after drying ; it is then placed upon the negative, the padding put in, then the back, and by means of the screws the paper is forced into close contact with the negative.

Whenever practicable, the exposure to light should be made to direct sunlight, when, from five to fifteen minutes will be sufficient, the time of year and of day, also the absence or otherwise of stain or veil on the lines, modifying the time.

In a dull light the time will be considerably more, and can only be learnt by experience.

The progress of the action of light can be seen by opening a portion of the back of frame, and examining part of the print, but extreme caution must be exercised in doing this, as the paper is liable to expand or contract when the frame is opened, and then, if not sufficiently exposed, the lines will be blurred ; when the exposure is sufficient, the image

is brown on a yellow ground, and the progress may, to a great extent, be judged by the depth of the margin outside the picture.

When the print is exposed, the next operation will be to ink it up, for which purpose it is placed upon the board described in last Chapter (fig. 3); the board being placed upon the bench, close to the inking slab, (a litho stone or a board covered with a sheet of zinc), a little photo transfer ink is mixed with turpentine by means of a palette knife, a glue roller is then charged with the ink, and the transfer is at once rolled up, the roller being used one way only, *i. e.*, from top of board, and is continued until the turpentine has evaporated, leaving a thin, even film of ink upon the paper, through which the image can be seen distinctly. Be very careful over the operation; if the ink is at all thick, and the image invisible, the transfer will be no use. When the transfer is inked up, allow it to lie for five minutes, then put into a dish of clean cold water, and soak for ten or twenty minutes; put it face up on a smooth slab, and rub over with a pad of wet lint, which will remove most of the ink from the whites; then put back into the water (which should be changed) until the whole of the bichromate is removed, when the whole of the loose ink is cleaned away from the picture, leaving a replica of the original in ink, with every line clear and distinct; rinse with water, place between sheets of blotting paper, and pin by the four corners to a board till dry.

With ordinary care the above method is simple and certain, the only chances of failure (providing of course that a good negative is used), are, too little methylated spirits of wine in the sensitising solution, too much ammonia, or too long immersion therein, or drying the paper at too low a temperature, or in the presence of foul

air, the remedies for which are obvious, the result being the same in each case, viz., refusal of the ink to leave the whites. The bichromate must always be removed from the transfer, or trouble will arise during transfer.

To prepare the transfer paper at home, good hard sized wove, *not laid*, writing paper is coated twice with a solution of gelatine as follows :—

Gelatine (Nelson's Amber)	...	...	3 ounces.
Sugar	...	...	$\frac{1}{4}$ ounce.
Water	...	...	40 ounces.

Soak the gelatine in jar until quite soft, add the sugar, and put the jar into a pan of cold water, place on a gas, or paraffin stove, and raise the temperature very gradually until the gelatine is all dissolved, add 1 dram of a 20 grain solution of chrome alum, stir well, strain through muslin into a clean dish, standing in a larger dish containing hot water.

Roll up the sheets of paper (not less than half-demy) face out (and be sure it is face out) rather tightly, place the loose end of sheet on the hot gelatine, and as it curls up, release the roll, take hold of the end at each corner and lift slowly from the gelatine, by which means the paper will receive a nice even coating of gelatine; directly the paper is lifted free from the gelatine, at once reverse it, turning it upside down and repeat this again and again until the gelatine sets, then either pin the sheet up to dry, or throw over a line.

When dry, another coat should be given in the same manner, so as to quite ensure filling the pores of the paper and getting rid of all paper texture.

When dry the second time, the paper must be calendered, either by being pulled through a litho press in contact with

a smooth stone, or by being rolled between shallow boards, in a rolling press.

Paper so prepared may be done in quantity as it improves with age.

For use it is floated for 3 minutes upon—

White of	...	...	...	...	20 eggs.
Water	...	...	...	...	20 ounces.
Saturated Solution of Bichromate of					
Ammonia	...	...	...	...	10 ounces.

Then dry in a drying box at about 70 to 80 degrees fahrenheit, after which it is used exactly as directed for Husnik's paper in last chapter.

Instead of sensitizing upon the above solution, the paper may be sensitised by immersion for three minutes in—

Bichromate of Potass	...	...	1 ounce.
Water	...	...	20 ounces.

and dried in the dark.

Expose under the negative, then immerse at once in clean cold water until the bichromate is quite removed, place upon the inking board (fig. 3), blot with a clean cloth, then roll up with the glue roller charged with transfer ink, thinned with turpentine, continuing the rolling until all the lines have received a thin coat of ink, and the whites are nearly if not quite clean, then a gentle rub with a wet pad of clean lint will remove all ink from the whites, blot off, then dry.

Another method of making transfers is to coat a good smooth hard sized paper with—

Arrowroot (Bermuda)	...	...	4 ounces.
Bichromate Potash	...	...	1½ ounces.
Water	...	...	60 ounces.

moisten the arrowroot with cold water first, then add the remainder of water boiling, in which the bichromate is dissolved, stirr well, then at once coat the paper and dry.

Expose as usual under the negative, ink up dry, and develope by immersion in water at a temperature of 100 degrees F., removing the surplus by means of a pad of lint.

PART IV.

PHOTO-LITHOGRAPHY IN HALF-TONE.

CHAPTER 1.

Photo-Lithography in Half-Tone.

IN Photo-Lithography in line, the transfer is made from a drawing or engraving in line, dot, stipple, or chalk, but in Photo-Lithography in half-tone, an ordinary photographic negative from nature, or a washed drawing, may be transferred to stone and worked either on a hand press or upon machine, the requisite breaking up of the half-tones (technically called grain) being effected during the process of making the transfer, either by using a lined or stippled screen in front of the sensitive plate, by impressing a dot or stipple upon the sensitive transfer paper, previous to exposure to light under the negative, or by exposure to light under the negative of a film of bichromated gelatine, supported upon paper or upon glass.

The first method of using a lined screen does not give very fine results, the grain being apt to overpower the high lights and flatten the picture; the second method is somewhat similar, but the high lights may be worked in, and very good results may be obtained, provided, of course, that an artist finishes the transfer upon the stone; the other two methods, both photographically and lithographically, call for very high skill, care and patience, the grain being obtained by drying the film of bichromated gelatine at a high temperature, thus causing it to reticulate, which reticulation, by breaking up the smooth gradations of photographic half-tone, enables the ink image to be transferred to stone, and worked as a lithograph.

The purest form of Photo-Lithography is the collotype process, which yields prints at press and machine, in much the same way as lithographs are printed, the results vieing in quality and brilliancy with the best solar photographs, but unfortunately, collotype prints cannot be printed so rapidly as lithographs ; therefore, for many purposes, they are too costly, hence the necessity of transferring to stone, in order that the cost of printing may be less, and that without in any way destroying the photographic character of the picture.

As well as the methods indicated above for obtaining half-tone transfers to stone from ordinary photographic negatives, there are others which may be mentioned, and which, for some purposes, may suit as well as the best ; for instance, a grained zinc plate, prepared with Bichromated Albumen (Chapter VI., Part I.), exposed under half-tone negative, inked up and developed, will give transfers in which the half-tones are broken up very nicely. An ordinary collotype print can be transferred to a fine grained stone, or the print from the collotype plate may be pulled upon grained or stippled transfer paper, and then transferred to a smooth stone.

In all of these processes of half-tone transfers, the first thing to learn will be care and patience ; give each part of the process its proper time, do not hurry it up, and then, when failure ensues, blame the process ; more failures are caused by over anxiety to get at final results, before the proper time, than by anything else.

In the following Chapters various methods of producing half-tone transfers will be given, but one method (and that a very important one) will be found in the last Chapter of

the Collotype. It is not treated here in what may be called its proper place, because it is practically a collotypic process, the same apparatus, &c., being used, as will be treated of in describing the collotype process.

CHAPTER II.

Grained Transfer Paper.

A perfectly smooth and *well polished* Lithographic stone is grained with fine flour emery, (washed, and sifted through fine muslin,) the muller used being of glass (a piece of plate glass will do).

To grain the stone, sift over it the flour emery, moisten this thoroughly with water, then rub with the muller round and round in short circles, wash off and renew the emery directly its tooth has gone, or the grain of the stone will be too smooth; continue the graining until the whole of the stone is evenly grained all over, then wash thoroughly and allow to dry.

The stone should now be gone over with good hard Lithographic chalk crayon, a rather tedious operation, but a very necessary one; use the crayon with a light hand, so that only the tops of the grain are touched.

The next operation will be to etch the stone with diluted nitric acid, so as to destroy the saponaceous character of the Lithographic crayon, and render it capable of withstanding water. To etch the stone, place it on the sink, and take a solution of gum arabic, the thickness of linseed oil (50 parts), nitric acid (one part), stir thoroughly so as to well mix the acid with the gum, in this dip a broad camel's hair brush

(not less than four inches wide), and brush over the stone in rapid strokes, from left to right, and right to left, until the stone is well covered, keeping the brush well charged with gum ; then repeat the operation across these strokes, wash well under the tap, gum up with a soft sponge charged with plain gum, and allow to dry.

When the gum is quite dry, put the stone on the press, and with a wet sponge moisten the gum thoroughly, wipe with a damp soft rag, and roll up the stone with a Lithographic roller charged with stiff transfer ink, damping and wiping with the rag at intervals. A piece of the sensitive Photo-Litho transfer paper (prepared for Line Photo-Litho, see page 93,) is pulled through the press with the prepared surface, in contact with the inked up grained stone ; the paper upon removal will be covered with a fine stipple, which will form the grain for breaking up the Photographic half-tones ; the stone, when finished with, is gummed in, and when dry, put away till again required.

This operation of pulling through the press must be done in a room illuminated by yellow light, or by gas, or oil light, to avoid spoiling the sensitive paper.

The sensitive transfer paper is now exposed to light in the printing frame, under an ordinary half-tone negative, until the image is as distinct as possible through the interstices of the ink.

The print is then put upon the inking board, and inked up with a glue roller, charged with Photo-Litho transfer ink, thinned with turps, until the whole sheet is covered with a thin even film of ink, when it is put into a dish of clean cold water, and allowed to soak for fifteen or twenty

minutes ; then it is placed upon a smooth slab, and gently rubbed with a pad of wet lint, and the whole of the loose ink is gently washed away ; if the whole of the yellow bichromate is now removed, the print may be blotted off and pinned on a board to dry, but if not, it must be soaked until free from the bichromate, then blotted off ; when dry, the print is then ready to be transferred to a smooth stone, after passing through the damping book as usual.

The negative used should be soft and not too brilliant ; if at all chalky, the result cannot be good, a thick over-exposed negative being quite inadmissible.

Instead of working up the grained stone with the crayon, it may be inked up with a glazed roller and stiff ink, but this will require plenty of care and an extra amount of skill. When rolled up properly, etch, wash, and gum up as before.

After impressing a sheet of the sensitised paper, the stone must be damped and rolled up with ink before impressing another sheet, and before putting away for any time, the stone must be covered with gum, and the gum allowed to dry.

When the transfer is on the stone, the high lights must be put in by scraping or polishing, taking heed that outlines are taken out with a gradually softening outline ; heavy shadows may be painted in with a brush after etching, as if done when gum is present the work will not stay.

If there be any difficulty in having the Litho press in a dark room (*i.e.*, a room illuminated by yellow light, or by gas, or oil), the paper in an insensitive state may be impressed and sensitised afterwards.

CHAPTER III.

Husband's Papyrotint Process.

THIS process has been named Papyrotint, being a modification of Captain Abney's improved method of Photo-lithography, named Papyrotype. It is specially adapted for the reproduction of subjects in half-tone, such as architectural drawings in monochrome, or subjects from nature, and it is inexpensive. Its advantages over other methods of half-tone photo-lithography are, that a transfer can be taken in greasy ink, for transfer to stone or zinc *direct* from any negative, however large, without the aid of a medium, the grain or reticulation being obtained simply by a chemical change. The transfer paper being in direct contact with the negative, the resulting prints are sharper than by those processes where interposed media are used; whilst the same negative will answer either for a silver print, platinotype, or a transfer for zinc or stone. The advantage of being able to use a non-reversed negative is very great, now that gelatine plates have so largely superseded those made with collodion.

The method of manipulation is as follows: a hard sized writing paper is floated on a bath composed of—

Gelatine (Nelson's flake)	...	...	8 ounces.
Glycerine	...	...	1½ "
Chloride of Sodium (common salt)	...	2	"
Water	...	...	50 "

Great care should be taken that the solution is not over heated, and that the paper is coated without bubbles. It is then dried in a temperature of 90 F. degrees. The paper will take about ten hours to dry, and in this state will keep for years. When required for use, it should be sensitized by floating, or immersing in a bath of—

Bichromate of Potash	...	...	1 ounce.
Chloride of Sodium	...	...	$\frac{1}{2}$ „
Ferricyanide of Potassium	...	...	100 grains.
Water	...	...	30 ounces.

This need not be done in a dark room as the solution is not sensitive to light.

The paper, after sensitizing, is dried in a temperature of 70 degrees, and in a dark room. When dried it is exposed under any half-tone negative, in the ordinary printing frame. It is preferable to print in sunlight, and for negatives of medium density, an exposure of three minutes is required ; but the exposure will vary according to the density of the negative. The correct time of exposure can best be judged by looking at the print in the frame. When the image appears on the transfer paper of a dark fawn colour, on a yellow ground, the transfer is sufficiently printed. It is put into a bath of cold water for about ten minutes, until the soluble gelatine has taken up its full quantity of water ; then taken out. placed upon a flat piece of stone, glass, or zinc plate, and the surface dried with blotting paper.

The action of the light has been to render the parts to which it has penetrated through the negative, partly insoluble, and at the same time granulated. A hard transfer ink is now used, composed of—

White virgin wax	...	...	$\frac{1}{2}$ ounce.
Stearine	...	...	$\frac{1}{2}$ „
Common resin	...	...	$\frac{1}{2}$ „

These are melted together in a crucible over a small gas jet and to them are added 4 ounces of chalk printing ink, and the mixture reduced to the consistency of cream with spirits of turpentine. A soft sponge is saturated with this mixture and rubbed gently over the exposed paper (in this stage the nature of the grain can be best seen). An ordinary letterpress roller, charged with a little ink from the inking slab, is then passed over the transfer, causing the ink to adhere firmly to the parts affected by the light, and removing it from the parts unacted upon. It will be found that with practice, rolling slowly and carefully as a letterpress printer would his forme, the ink will be removed by the roller according to the action that has taken place by light, leaving the shadows fully charged with ink, and the high lights almost clear, the result being a grained transfer in greasy ink. The transfer is next put into a weak bath of tannin and bichromate of potash for a few minutes, and when taken out, the surplus solution should be carefully dried off between clean sheets of blotting paper. The transfer is hung up to dry, and when thoroughly dry, the whole of the still sensitive surface should be exposed to light for about two minutes. A weak solution of oxalic acid should be used for damping the transfer (about 1 in 100), and this should be applied to the back of the transfer with a soft sponge. After it has been damped about four times, it should be carefully put between clean sheets of blotting paper, and the surplus moisture removed. A cold polished stone is then set on the press, and after everything is ready the transfer is placed on the stone and pulled through twice. The stone or scraper is then reversed and the transfer is again twice pulled through. A moderate pressure and a hard backing sheet should be used, care being taken not to increase the pressure after the first pull through. The

transfer is taken from the stone without damping, when it will be found that the ink has left the paper clean. Gum up the stone in the usual way, but if possible, let the transfer remain a few hours before rolling up. Do not wash it out with turpentine, and use middle varnish to thin down the ink.

It should have been mentioned that varying degrees of fineness of grain can be given to the transfer by adding a little more ferricyanide of potassium in the sensitizing solution, and drying the transfer paper at a higher temperature, or by heating the paper a little before exposure, or by adding a little hot water to the cold water bath, after the transfer has been fully exposed; the higher the temperature of the water, the coarser the grain will be. The finer grain is best suited to negatives from Nature, when a considerable amount of detail has to be shown. The coarse is best for subjects in monochrome, or large negatives from Nature, of architecture, &c., where the detail is not so small.

PART V.



COLLOGRAPHIC PRINTING.



ColloTYPE Print, Waterlow & Sons Limited, London.

Collotype.

IN the processes of Photo-Zincography and Photo-Lithography, the original must be a drawing or engraving in line, dot, or stipple, but in Collotype, negatives from nature can be used, and prints made at press or machine in ink, the smooth half-tones being represented in the same degree of gradation as in an ordinary silver photograph.

Collotype prints are made from a thin film of bichromated gelatine dried upon a plate of thick glass, exposed to light under a negative from nature, the film of gelatine taking ink from the roller exactly in proportion to the amount of action of the light during such exposure.

Negatives for Collotype must be of the very best quality, soft, without flatness, brilliant, without hardness, possessing full gradations of tone from the deepest shadow to the highest light; negatives that are hard and under-exposed, or flat and dirty, are quite useless for Collotype.

Negatives for Collotype may be made either by the wet collodion or by the gelatine dry plate process, the wet process being best when film negatives are required, that being the best form of negative for printing from upon the Collotype plate, contact being so easily obtained between the whole of the negative and the Collotype plate; that not being the case with negatives upon the ordinary dry plates of commerce, they being as a rule far from flat, and either break in the printing frame, or give a blurred image.

Negatives for Collotype must be reversed, and if made with a reversing mirror behind the lens, either by the wet or dry process, patent plate glass should be used to make them upon, or may be made without the mirror, and then

stripped and (in the case of a wet collodion plate) made into a flexible film, or, (if a dry plate) taken from its original plate, and transferred to a sheet of patent plate glass.

Negatives for Collotype that are too valuable to run the risk of stripping must be reproduced; a carbon transparency being first made, the reversed negative being made from this, by contact upon an ordinary dry plate.

If the gelatine dry process be used, the new celluloid films will be found very good indeed, being flexible, contact is easily obtained in the printing frame.

In the Appendix both wet and dry process will be treated of for the production of half-tone negatives for Collotype.



CHAPTER I.

Preparing the Collotype Plate.

FOR the preparation of a collotype plate an oven is required, in which the plate of thick glass can be dried quite level and free from dust.

Here are dimensions of oven to dry two plates, each 15×12 , it is a rectangular box 30 inches long, 18 inches wide, and 18 inches deep, inside measure, supported upon four legs 18 inches high; the bottom of the oven is of thin sheet iron and from the bottom six inches downwards is a jacket of sheet iron, thus forming a deep flange holding the heat from the gas used for warming the oven, the source of heat being simply U shaped, made of inch gas barrel with a smaller supply pipe screwed into the base of U, to be further con-

nected with the gas supply by means of an india-rubber tube, each arm of the **U** should be 24 inches long, and 10 inches apart, each arm to be perforated with five small holes, in each of which is fixed a Brays No 1 gas burner, same as are in ordinary every day use for lighting purposes, do not attempt to use an atmospheric burner of any kind, as it is impossible to control the temperature with an atmospheric burner, and also because they are very apt to fly back and cause a fire.

This burner is supported under the oven bottom upon a light iron stand, the top of the flames being about 2 or 3 inches below the sheet bottom.

On one side of the oven, one inch from the sheet iron bottom, a slit one inch high is left, going the whole width of the oven, and inside, some well washed silver sand is put about one inch deep upon the sheet iron bottom, so as to equalise the heat evenly all over; eight inches from top of oven two strong cleats one inch wide are nailed one on each end, to carry two iron bars, 30 inches long, 2 inches wide, half an inch thick; one bar having four thumb screws each four inches long (the point being tapered) each six inches apart, the other bar having two similar thumb screws only, so arranged as to come in the centre between each two screws on other bar, by this means each plate is supported upon three screws, and is easily adjusted quite level. The top of oven is a frame covered with red flannel, and raised from the oven about half an inch, so that there is a free current of air right through; in the centre of top, or lid of oven, a long thermometer must be fixed, the bulb being nearly level with the plates when upon the levelling screws, the scale being outside, so that the temperature inside the oven may be seen at a glance.

When gas cannot be obtained, parrafin lamps, or stoves may be used, lamps being perhaps the best, being easier to keep from smoking.

The plates upon which the collotype film is dried, is the best British plate glass, at least three-eighths of an inch thick, the size being determined by the size of paper upon which the the print is to be made, or by the size of the press to be used, the best and most economical plan will be to have not more than two sizes of plates in use, the largest that can be used, and a medium size for general use, plates 13 by 10, and 15 by 12, will be very useful sizes.

The glass free from scratches is first of all ground upon one side, which is done by laying one plate upon a couple of bearers, placed across the sink, sprinkled with some fine emery powder, and then with a little water, now place another plate on top of emery powder, and grind with a circular motion, continuing the grinding until the emery is worn nearly smooth, now wash both plates, squeegee the water from plates, and examine, and if the whole of the surface is evenly ground, the plates are ready for the next stage, if not, cover again with emery and water, and continue the grinding until the surface of both plates are evenly ground all over, when only patches are left unground, finish with a small piece of plate glass and emery.

The plates being ground, they are well rinsed under the tap, both sides well scrubbed with a stiff brush, washed free from emery, &c., and allowed to get quite dry ; when quite dry, lay on a clean sheet of paper, put on the surface a few drops of—

Liquor Ammonia	...	...	2 ounces.
Spirits of Wine	...	...	2 „
Water	...	...	5 „

Rub this well all over with a piece of papier Joseph, and then rub dry with another piece of the same paper. Good clean rag quite free from grease may be used for this purpose, but the papier Joseph will be the best, cheapest, and more certain.

The plate is next coated with—

Stale Beer	...	...	5 ounces.
Syrupy Silicate of Soda	...	...	1 ounce.

Mixed thoroughly, then filter, (this solution should be mixed at least 12 hours before using,) when the plate is covered with the above solution, it is drained slightly, then put in the oven on the levelling screws, and dried at a temperature of from 120 to 140° F. When dry the plates are removed from the oven, allowed to cool, rinsed under the tap for one minute, and dried on a rack spontaneously, in this condition the plates will keep for any reasonable length of time.

CHAPTER II.

Sensitive Collotype Mixture.

The glass plate having received its preliminary coating, which is to hold the sensitive gelatine film down upon the plate during the printing operations, it is next placed in the drying oven, carefully levelled and warmed to a temperature of 110 degrees F., previous to being coated with a solution of bichromated gelatine.

This sensitive gelatine is made as follows :—

STOCK GELATINE.

Gelatine	...	...	...	2 ounces.
Water	...	...	...	10 ounces.

Soak the gelatine till soft, then put in a "Bain Marie"

place on a gas stove, raise the temperature gradually, until the gelatine is all dissolved, then add half an ounce of bichromate of potass in very fine powder, and stir until dissolved, add ten drops of liquor ammonia, again stir well, then let it stand until set.

When the plates are in the oven and ready for coating, take of the above jelly one ounce, or about, and put into a clean jar ; placing this jar into a pan of hot water, until the jelly is melted ; when melted, pour into a warm measure and if there are eight drams it is all right, if not add a little more jelly to make up to the desired quantity, return the gelatine to the jar, and keep it hot until eight drams of pure, or clean methylated spirit, have been warmed in a beaker to the same temperature, this is best done by placing beaker in the hot water with the jar containing the gelatine, now add the spirit to the gelatine, pouring it in very slowly, and stirring the mixture vigorously with a glass rod, until all the spirit is added, now add two drops of liquid ammonia, stir this well in, then strain through fine muslin into a warm clean beaker, cover the top of this beaker with clean fine muslin, previously dipped in hot water, and proceed to coat the plates warming up on the levelling screws, hold the plate on the palm of the left hand, dust with a flat camel's hair brush, then pour over the plate, eight drams of the mixture of gelatine and spirits of wine, flowing it all over the surface, now pour about 2 drams of the solution off the plate, leaving six drams only for a plate 13 by 10, that being the size the above quantities are intended for, now place upon the levelling screws as nearly in the same place as when levelled, coat the other plate in the same manner, then close the oven and leave till dry, which will take about 40 minutes at a temperature of 110 degrees F.

The method given above must be carried out exactly as given, if more than above quantity be left upon the plate the prints will be mottled, the spirits of wine is very useful, enabling the exposed portions, to hold ink with a minimum of grain.

The temperature of oven during the time of drying the sensitive film, will vary with different samples of gelatine, some samples giving the best results when dried at 98 or 100 degrees F., whilst others must be dried at 120 degrees F., the temperature given, 110 degrees F., is a good medium temperature.

In purchasing gelatine for collotype it is a great mistake to get small quantities, as each sample has its own characteristics, even when by the same maker ; some samples require great modification in the formula, to get proper results, and a small quantity would be exhausted just as its peculiarities are ascertained, some gelatines require more than the quantity of methylated spirit given above, others must have less.

The plates being dried, may be removed from the oven, and when cold are ready for exposure to light under the negative, or may be kept for seven or ten days before use if stored in the dark and away from damp.

Previous to exposure, the negative must be masked with strips of thin tinfoil, in such a way as to prevent any part of the negative not required, showing in the finished print ; the tinfoil used for this must be very thin, and may be attached to the negative with india rubber solution. If a film negative be used, thin black, or any opaque paper may be used.

In addition to masking the negative, a brown paper mask is used to further protect the margin of collotype plate outside the negative, a very important measure, as if not so protected great difficulty will be found in inking up the image evenly, or in lifting up the mask without tearing.

The printing frame for collotype must have a plate glass front, the hinged back is not needed, the bars may have screws, or wedges may be used.

To fill in the frame, it is laid upon the bench, the bars are removed, the front glass thoroughly cleaned, the brown paper mask laid upon the glass, the negative put into its position, the collotype plate placed upon the negative, centre the image as near as possible, put in the bars, and either screw or wedge up, if the negative is on glass great caution must be used not to screw or wedge up too tightly, or the negative will be broken, but film negatives stand greater pressure.

The exposure to light should be made as a rule in diffused light, and the time measured by means of a Johnson's actinometer, from three to seven tints being the usual time with good ordinary negatives.

The progress of the action of light, can be seen by turning the frame over, and examining the image upon the collotype plate, brown on a yellow ground, the exposure is fairly rapid, in a good light with a clear negative will seldom exceed one hour.

When the exposure is complete, the plate is removed from the frame, and placed in a dish of clean cold water, the water being changed at intervals, until the whole of the bichromate of potash is removed; the plate is then put on a rack to dry. A wooden box with grooves like a plate box, with a tap at bottom to let out the water, may be used for soaking the plates in after exposure to light; and is recommended in preference to a flat dish.

CHAPTER III.

Presses &c. for Collotype.

For the production of prints from the collotype plate, a press, a leather lithographic roller, a typographic roller of glue and treacle, inking slab, ink, thin lithographic varnish, sponge, damping rag, mask frames, parchment paper, gold size, and a good sample of paper upon which to pull the proof are required.

The press used may be a typographic press of the form called Albion, an ordinary Lithographic press, or a special press made for collographic printing, of which there are several in the market.

If an Albion press is used, the platen should be lowered so that the requisite printing pressure can be obtained without the use of an inordinate amount of backing. To use an Albion press a piece of thick plate glass is first put on the bed with a sheet of white blotting paper underneath, upon this sheet of glass is placed another sheet of wet blotting paper, the collotype plate being placed upon this, the wet blotting paper holding the plate firm, and forming a couch for the collotype plate.

To use a Lithographic press, a smooth stone quite level is all that is requisite, the collotype plate being bedded upon a sheet of wet blotting paper; the tympan must be of metal, either thin brass or zinc, and fixed only at the back of tympan frame so as to avoid any danger from the buckling of the tympan under pressure, a piece of thin blanket being fixed on tympan frame in front of metal tympan. The

scraper must be shod with leather, and must be at least an inch shorter than the width of plate to be printed from.

The presses made specially for collotype printing, are fitted so that the plate is laid upon the bed of press, with a sheet of blotting paper underneath so that the progress of the inking up can be seen, the plate being kept in position by means of clamps, the pressure being in some presses a scraper, in others a roller.

Whichever form of press be used, the operation of printing from the plate will be just the same so that each operator can adopt that press which is handiest to him.

To obtain clean margins in a collotype print the plate must be masked, as it is impossible to get a clean margin without doing so.

There are various methods of masking, but the best way is to use an iron frame, made to fit over the collotype plate, this frame being covered with a sheet of thin parchment paper, the edges of paper being gummed or pasted round the iron frame, the paper wetted, and when dry it will be like a drum head, a coat of gold size painted upon the under side of parchment paper will, when dry, give a mask that with care will last a 1000 impressions. For a plate 13 by 10, the mask frame should be made of quarter inch iron rod, inside measurement of frame being $13\frac{1}{4}$ by $10\frac{1}{4}$, the inside corners to be square, the outside corners, either round or square, at least three of these frames should be provided for each press, so that in case of an accident to the mask, another one can be got ready in a few minutes, instead of delaying the work till the pasted paper and gold size are dry.

The rollers are very important and must be of the very st, the leather roller which is used first, must be a best

French skin, of the quality known to lithographers as a nap or chalk roller, *i.e.*, the grain of leather must be outside. A new roller must be properly prepared before use, and that will take from three to six weeks to accomplish, and when in good order it must be very carefully kept. Full directions upon the preparation and care of rollers will be given in a special chapter. The beginner is strongly advised to buy his first roller ready for use, which can be done at an advance of about 3/6 or 5/- upon the list price of a new roller. The best sizes of rollers are 10 inches and 12 inches long. With the rollers a pair of leather handles are requisite.

The second roller may also be of leather, but in this case a different kind of roller is required, *viz* : a colour roller in which the grain of leather is outside, these rollers require no preparation, beyond being kept clean, and free from ink when not in use.

The general form of second roller however, is a typographic roller of glue and treacle cast in seamless mould, and may be purchased from any Lithographic or Letterpress dealer.

The inking slabs (two) may be thin lithographic stones, or sheets of zinc screwed upon wood blocks, the size of these slabs should be at least 18 inches by 15 inches, so as to have plenty of room for rolling up the ink.

The ink must be the best quality lithographic ink, the black ink being known as best chalk ink; for making coloured inks, brown, sepia, red, and blue, are mixed in various proportions, to get the effect desired.

The ink as received is far too stiff to use and will require diluting with thin lithographic varnish, the ink and varnish being mixed either with a stone muller, or a strong palette knife.

The paper upon which the collotype prints are made must be of the best quality, with a smooth surface, a good enamel paper giving the richest prints, closely followed by Dickinson's Art Printing Paper, or a good plate paper.

CHAPTER IV.

Printing from the Collotype Plate.

TO prepare the collotype plate for the press it is first soaked in cold water for an hour, the back is then cleaned from any clots of gelatine that may have flowed over the edges during coating, the plate is then wiped with a soft sponge and dabbed with a damp soft rag, placed upon a levelling stand, and the surface covered with the so called etcher composed of—

Glycerine	...	...	...	5 ounces.
Water	...	...	...	10 ounces.
Oxgall	...	...	...	10 drops.

This is allowed to act for half an hour, during which time the press must be prepared, the nap roller scraped, the ink mixed, the second roller washed with turpentine, the slabs cleaned down with turpentine and a rag, and the printing paper cut to size; the mask frame should have been covered some time previously, and the gold size be quite dry.

All being ready the glycerine mixture is removed from the plate with a sponge, the plate placed upon the bed of press, the film dabbed with a soft cloth until the surface is dry, it is then rolled up with the leather roller, slowly and with plenty of pressure, when if all operations previously have been carefully attended to, the shadows will first take ink, followed by the

middle half-tones, the rolling being continued slowly and carefully until the picture is evenly inked with perhaps more than the proper proportion of ink upon the shadows, and little or none upon the high lights ; now take the second roller charged with ink a little thinner, (*i.e.* mixed with more thin varnish) and roll over the plate using a quicker motion, and less pressure, the result of which will be, that the surplus ink upon the shadows will be removed, and the lights will receive their due proportion, the image being more harmonious throughout. A mask is now laid over the plate in such a manner that the iron frame encircles the plate, the top being flush with the surface of plate, the image can be seen through the goldsized parchment paper, and a slight pressure of the finger upon the margin of print, will leave an impression of the picture upon the mask, which is now lifted away. Now roll up the picture again, first using the leather roller, then the second roller as before.

The mask is now placed upon a spare sheet of glass in the same position that it occupied upon the inked up plate, and after carefully measuring the mask upon the surface, two lines at right angles to each other, by which the paper must be laid so as to get the colotype image in its proper position upon the sheet of paper to be used. This being done, the paper upon which the image is impressed is cut away, using a straight edge and a sharp knife to get a good edge, and cutting the aperture about a sixteenth of an inch larger all round than the actual size of picture, so that the mask will not cut into the margin too close up to the picture.

The mask is now placed over the inked up plate, and the opening will show the image, whilst the margin of plate will be covered by the parchment paper between the opening and the frame.

Lay the printing paper upon the mask, putting the edges against the lines marked for the lay, upon the printing paper put a sheet or two of blotting paper, lower the tympan, run the bed of the press under the platen, scraper, or roller, then carefully feel for the amount of pressure and if correct pull through, then return the bed, lift the tympan, remove the print and examine, if the ink has come away in patches the pressure has been too light, and more must be given for the next impression, a heavy pressure must not be used, or the plate will be sure to smash.

Should the print be very weak and flat, the ink is perhaps too thin, and must be mixed with fresh ink from the tin. Ink for collotype printing must have very little varnish with it, in fact only just sufficient to allow the ink to be spread upon the roller.

If the film has not been sufficiently soaked, the picture will also be flat, but in this case the margin will take as much ink as the shadows, in this case sprinkle a little turpentine over the plate, then deluge with water and wipe clean with a soft rag, cover the film with the etching solution of glycerine and water, and allow from half an hour to an hour to soak in, then wipe off and ink up again, do not waste the glycerine solution as it improves with use.

Sometimes after long etching and with very stiff ink, the image remains without high lights, in this case wash out with turpentine as before, wipe surface dry, then wash over quickly with—

Glycerine	...	...	...	5 ounces.
Water	...	...	...	20 ounces.
Cyanide of potassium	...	...	...	10 grains.

And as quickly wash off with a sponge saturated with water.

After a drastic course of this kind the plate may refuse to take ink at all, in which case remove from the press, and let the film dry again, then etch for half an hour, and ink up. The cause of this refusal is simply on account of the cyanide having softened the gelatine, the film has absorbed too much water, and consequently it cannot take ink, the drying down gets rid of the water, and restores the film to its normal state.

When any particular portions of the picture are wanted lighter than the rest, the plate should be wiped dry, and those portions painted over with the etcher, leaving it to soak in, for say fifteen minutes, then cover the whole film for ten minutes, wipe dry and roll up.

After each print is made, the mask is removed, the plate damped with the etching solution, by means of a sponge, then wiped or dabbed off with a soft damp rag, before again inking up.

Different tints of ink can be made by mixing several colours together, but it will be far better to buy the tints from the dealers, as it will then be mixed so much better than can be done by hand.

These preliminary stages of a collotype plate are very important, as if not properly carried out the subsequent operations will only be lost time, the old films must be thoroughly removed and the surface well re-ground, the silicate of soda and beer must be well filtered and sufficiently stale before use; if the mixture of beer and silicate after standing a few hours (after mixing) precipitates in a flocculent mass, the silicate is not good, and a fresh sample should be obtained; the beer and silicate should be kept at least six hours before using.

Instead of beer albumen may be used, the whites of five eggs, mixed with ten ounces of water, well beaten up, then add two ounces of silicate of soda, and keep six hours before use.

The plan of using a substratum of bichromated albumen, or gelatine, is not recommended as it is troublesome and tedious, and demands the use of a tank of hot water in which to soak the plate before coating with the sensitive gelatine solution, else the collotype film will peel off under the roller.

CHAPTER V.

Printing Collotype Plates upon a Litho. Machine:

MACHINES for collotype printing differ from lithographic machines in the fact that they are supplied with a double set of inking rollers, one set (of glue and treacle) in front of the cylinder, the other set (of leather) being behind the cylinder, upon the cylinder there is also a semi-circular skeleton frame for masking the margins of the collotype print, an arrangement not required in lithographic printing; the coffin of the lithographic machine must also be filled up to compensate for the difference between the thickness of a lithographic stone (about $2\frac{1}{2}$ inches) and the collotype plate ($\frac{3}{8}$ of an inch) this is best done by using the bed-plate supplied by most makers for fixing zinc plates for printing from upon the machine, and this being easily procurable we need not trouble much about it.

The extra set of rollers and the mask are the most difficult to manage, but almost any machinist will be able to convert a litho machine into one capable of printing impressions from the collotype plate.

What is required then is, beyond the holders for the two damping rollers behind the cylinder, a set of holders must be fixed for four printing rollers, exactly as for the rollers in front of the cylinder, and beyond these again, holders for distributing ink upon the damping table (replaced by a marble slab.) The whole of these holders must be made the proper depth to allow of riders, and fitted with springs so that the rollers may be lifted from the plate directly the image has passed, this lifting being effected at the proper place by moveable inclined planes upon the frame work of machine.

The mask is fixed on pivots, the holes for which are bored in collar of cylinder, a thumb-piece projecting at the top for the feeder to lift clear of the cylinder when it returns after the impression, this mask frame is fitted with four strips of lateen brass arranged so that they can be moved laterally so as to form an opening in the centre the size required, for one plate perhaps large, the next one much smaller; the feed-board will require cutting away a little so as to allow this mask-frame to get under the board as the cylinder comes round.

Another method of arranging the mask is to do without the frame, and to have an arrangement under the grippers to clamp a sheet of varnished paper, much simpler and quite as effective as the semi-circular frame.

In printing from the collotype plate the ink duct on the machine is not required, as the ink is usually used so strong and in such small quantities, comparatively, that the feeding of the riders is quite sufficient.

Collotype prints cannot be made at the same speed as lithographs, *viz.* from 500 to 800 an hour, 200 an hour will be found very good work, therefore the driving-shaft will

require altering and a smaller pulley used ; the inking of a collotype plate takes longer than a litho stone, so the feeder will require to use his lever and give extra inking runs, unless the machine be fitted with change gear allowing of inking runs, 2, 3 or 4 times, between each impression.

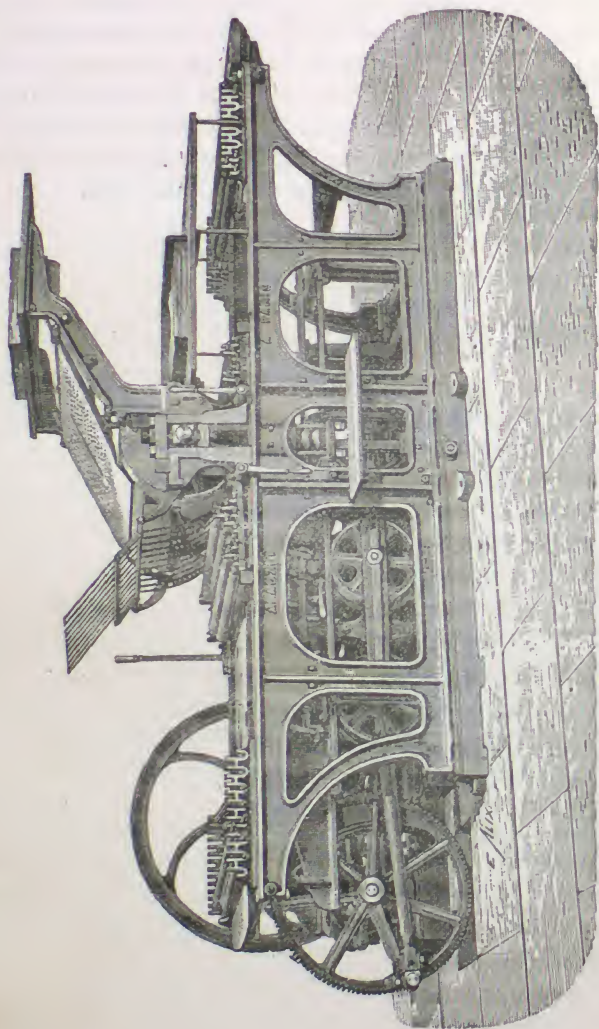
To a lithographic machineman collotype printing will present a curious topsy-turvydom, as the leather rollers which do the inking of the block are placed at the other end of the machine to which he is in the habit of working them, and the rollers in front of the cylinder require so little ink and so little attention, that it will be some little time before he can get quite reconciled to the changes.

There being no possible means of automatic damping, as in litho printing, the collotype plate must be damped (or etched, as it is erroneously called) with glycerine, more or less diluted with water, so as to check evaporation and also absorption by the paper, a well damped plate will run from 80 to 100 impressions before the operation of damping will require repeating. When the plate requires re-damping the machine is stopped, and the plate covered with the glycerine and water to which is added ox-gall, common salt or ammonia, each printer having his pet formula, the fluid is allowed to soak into the film for four or five minutes, then it is removed with a sponge, and the plate dabbed free from moisture.

The image should not be printed in the centre of the glass plate, but at about an inch or an inch and a half from the edge, so that the grippers holding the paper may clear the plate without striking it.

The cylinder covering should be a sheet of india-rubber, under which is placed a piece of thick smooth paper a trifle smaller in area than the picture to be printed, this paper

being placed exactly over the image by means of an impression sheet taken beforehand ; by having this arrangement no portion of the margin receives any pressure, by which means cutting the film by the edges of the mask is avoided, and many more impressions may be obtained from each plate than would be possible if the whole plate was impressed, and the mask gradually cut its way into the film.



CHAPTER VI.

**Photo-Lithographic Transfers from
Collotype Plates.**

TO make half-tone photo-litho transfers from collotype plates, the glass plates are ground, cleaned, and coated with the mixture of silicate of soda and beer, then coated with the sensitive gelatine mixture (made a little thicker, and mixed with ferricyanide of potassium, etc.,) exactly as for ordinary collotype plates.

The formula for the jelly is—

Gelatine (Nelson's Amber)	...	2 ounces.
Water	... ..	8 „

Soak the gelatine till quite soft, then melt by placing in a jar, putting this jar into a pan of water, commence with the water cold and raise the temperature gradually, when the gelatine is all dissolved add half an ounce of bichromate of potash in a fine powder, and stir until dissolved, then allow to cool and form a stiff jelly.

For two plates each 15 by 12, sufficient of the above jelly to make two ounces of solution (say $2\frac{1}{2}$ ounces by weight of jelly), is melted in a clean jar, the jar being put into a pan containing hot water, whilst the jelly is dissolving, warm two ounces of methylated spirits of wine in a beaker (put the beaker into hot water) add 10 drops of a saturated solution of ferricyanide of potassium, and two drops of glycerine, mix, and when warm add slowly to the gelatine stirring vigorously all the time. If the spirit be added too rapidly, and without the vigorous stirring, the gelatine will be coagulated and the mixture spoilt, add the spirit very slowly and stir vigorously during the operation, then the gelatine mixture will be clear and limpid without any coagulation at all.

The plates already coated with the substratum of beer and silicate of soda, dried, rinsed and again dried, are warmed slightly in the oven and levelled, the gelatine solution is now filtered through two thicknesses of fine muslin into a warm glass measure, a piece of fine muslin is tied over the mouth of measure, the plates are then coated, each plate being allowed twelve fluid drams of the mixture, the plate being returned to the oven and placed carefully upon the levelling screens, and dried at a temperature of 150° F.

When dry the plates are exposed under a thin half-tone negative (reversed), the margin of plate outside the negative being masked with thick brown paper. If this is not done it will be almost impossible to get the image properly rolled up. The exposure must be thorough so as to get detail in all parts of the picture, when removed from the printing frame the plate is washed in frequent changes of water until the whole of the bichromate is removed, when it is put on a rack to dry.

When dry the plate is soaked in clean cold water for from 3 to 5 hours, after which clean the back and put the plate upon the press, then roll up with a leather roller charged with transfer ink, and pull a few impressions upon any good printing paper, until the plate is got into good working order, then pull an impression upon coarse Scotch transfer paper, or upon Josz's chalk paper, after which transfer to a well polished stone, and work exactly as an ordinary chalk stone. Do not be in a hurry to ink up, and prove after transfer, but gum in, and allow to stand at least twenty-four hours.

Scotch paper suitable for these transfers, is made as follows:-- Four ounces of coarse plaster of Paris is put into a quart basin with sufficient water to cover it, stir with a spoon until the plaster thickens, now add a little more water, and stir well

until the plaster again thickens, more water is added, and the stirring continued, until the tendency of the plaster, to set is quite overcome, an operation that will occupy from twenty to thirty minutes. Dissolve a quarter of an ounce of glue in ten ounces of water, and with this moisten three ounces of flour, then put on the fire until it boils, and turns into a thick paste; mix this paste with the plaster, stirring well until the two are thoroughly mixed; then strain through canvas so as to get rid of lumps.

Good ordinary printing paper is coated with the above composition, by having it brushed over with a broad stiff brush, brushing first one way and then the other until an even coat of the composition is put on the paper, free from lumps, or streaks. When this is done the paper is hung on a line to dry; and before using to take a transfer impression from the collotype plate, it is placed in a damping book until just limp, but not sticky to the touch.

APPENDIX.

APPENDIX.

The Nitrate of Silver Bath.

IN the ancient days of Photography, when, to say it was possible to prepare a dry plate nearly as sensitive as wet collodion, was to excite the risible faculties of the audience, the above heading might almost always be seen in the Journals, and the amount of matter written under that heading would fill a many good sized volumes, some writers going into the subject in a very elaborate manner, whilst others would counsel very simple methods of preparation and management.

The directions given in Chapter II. for making a bath solution for line negatives, will, if carried out carefully and cleanly, at once yield a solution giving good negatives. After the bath has been mixed, either with distilled water, ordinary tap water (*in iron districts tap water should not be used*), or water that has been sunned and filtered (page 9), as soon as the bulk has been made up to the 80 ounces, the solution should be put away all night before it is tried, then in the morning filter it carefully through a pledget of cotton wool stuffed loosely in the neck of a perfectly clean funnel, into a perfectly clean bottle, or jug, which must be kept entirely for use of the silver solution. When the bath solution has been filtered it should be *perfectly clear*, if it is at all cloudy or turbid, the filtration must be repeated.

When the solution is perfectly clear and bright, pour sufficient into a perfectly clean porcelain, glass, or papier-mache dish, then take a clean plate (polished, or albumenised)

and coat with collodion, then close the door of the dark room, and when the film of collodion is perfectly set, raise one end of the dish containing the silver solution, place one edge of collodionised plate against the bottom of the upper edge of the dish, then drop the plate upon the bottom of the dish, and at the same time lower the dish, by which means the silver solution will flow in an even wave over the surface of the collodionised plate; now place the cover on the dish so as to exclude light and dust, and allow the plate to remain in the solution for five minutes, then with a silver hook lift the plate from the solution, and allow to drain (remember that no light must get into the dark room except what is filtered through either two thicknesses of golden fabric, or one of canary medium), when the plate has drained so that no solution drips from the plate, place it into the carrier of dark slide, then close the dark slide and let it remain there for five minutes, at the end of which time remove the plate to the sink, and flood with sufficient developer (page 8,) to just cover the film; keep this solution flowing to and fro over the plate for the space of two minutes, wash under the tap until the surface is no longer greasy, then apply the fixing or clearing solution (page 13), until the whole of the yellow bromo-iodide is dissolved away, again wash, and take the plate into the daylight.

Now comes the test; if the film is perfectly transparent, the bath is all right, but if there is the slightest deposit (which can be removed by lightly rubbing the finger along the surface of film), then the solution will require the addition of a little Nitric Acid, well stirring up, and after a rest of an hour or two trying again, repeating the addition of the Nitric Acid, and trying the plate until the film after developing, washing, and fixing is perfectly clear, and free from deposit and fog.

The bath is now in proper working order, and, if reinforced after each day's work, with a sufficient quantity of saturated solution of nitrate of silver (filtered); and kept free from any contamination with other chemicals, and carefully filtered occasionally, the bath will remain in good working order for at least six months, and then may be renewed by treating as directed in top paragraph on page 11.

It will sometimes happen, notwithstanding that extreme care and cleanliness is exercised in the management of the bath, still it will not work properly, and the reason why cannot easily be discovered, in such a case, steps must be taken to put the solution into working order.

In the case of rectifying a disordered bath, there are many methods of procedure, but the simplest, and as a rule the most certain method, is to render the solution alkaline, by the addition of Liquor Ammonia, adding the ammonia a little at a time, then after well shaking, testing with red litmus paper, continuing the addition of the ammonia, until the red litmus paper is turned blue. In this alkaline condition the solution should be poured into a large flat dish, and exposed to the action of the sun, which will speedily reduce and throw down in the form of a black precipitate, any organic matter that may be in the bath, and at the same time the heat of the sun will cause the evaporation of the ether and alcohol left in the solution by the collodion plates.

The bath solution should be left in the sun for two or three days, or until such time as suffices to render the solution clear, and the precipitate entirely separated out, but this cannot take place unless the solution is decidedly alkaline, the presence of acid stopping the action of light.

Do not be in a hurry about doctoring a bath solution (in fact it will be far the best to have two solutions, one in use and one either resting or being doctored), but give the light plenty of time to reduce the organic matter, and also to volatilise the ether and alcohol, then filter the solution through a filtering paper (don't use blotting paper), as if it is attempted to filter through a pledget of cotton wool, the fine precipitate of organic matter quickly clogs the wool and stops the filtering.

The doctored solution being filtered, test it with a piece of perfectly fresh, blue litmus paper, and add nitric acid, drop by drop—shaking well between each addition of acid—until the blue litmus paper just turns red, do not add acid sufficient to make the litmus turn violently red, unless the bath is for line negatives, as a bath for half-tone negatives must be only just acid, whereas a bath for line work must contain more acid.

The colour of the litmus paper showing that the alkali has been neutralised, a plate is collodionised, then immersed in the bath for five minutes, then drained, and placed in dark slide, or a dark box for five minutes, then flooded with the iron developer (page 12), and if upon the application of this the film should turn black, add more nitric acid, stir up thoroughly, then try again, repeating the trials until upon fixing the plate with the solution of cyanide of potassium, the film of collodion is left upon the glass plate, as clear as it was before immersion in the silver bath.

A little above here it is stated that for half-tone negatives less nitric acid is required in the bath for half-tone negatives than for line work, and the question may well be asked where may the line be drawn, the reply to which is, for half-tone work, a piece of blue litmus paper should, upon

immersion into the solution turn red very slowly, but when the bath is required for line negatives, the blue litmus should at once indicate the presence of acid.

After a bath solution has been renovated in the above manner it should be tested for strength, either by the volumetric method (by preference), or by means of the ordinary argentometer sold by the dealers, and if, after testing, the strength is shown to be too great, dilute with a sufficiency of sunned water (page 11); and if not sufficiently strong, add crystals of nitrate of silver to make up the strength to thirty or thirty-five grains per ounce.

A bath solution renovated as above, will generally be found to work cleaner, and yield brighter negatives than a new solution, and it will also, if carefully used, last longer, but it must be kept up to a proper working strength by the occasional addition of a little of a saturated solution of nitrate of silver.

The fact that the strength of the silver solution has got too low is shown by the presence of semi-opaque, fantastic markings near the thick edge of the collodion film, and also in conjunction with the presence of organic matter in the deposition upon the surface of film, of an extremely fine sand-like deposit, which in the fixed negative, develops into myriads of pinholes in the densest portions of the image.

For half-tone negatives, instead of fixing or clearing with the Cyanide of Potassium, directly the developer is washed off, and then intensifying afterwards, they are intensified at once by the application of a mixture of pyrogallie acid, citric acid, and nitrate of silver, as follows:—

No. 1 Solution Pyrogallie Acid	...	40	grains.
Citric Acid	... ..	30	grains.
Water	... ..	20	ounces.

as much of this solution as will cover the washed plate is put into a small cup and flowed all over the film, then returned to the cup, and a few drops of

Nitrate of Silver	30 grains.
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Water	1 ounce,
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is added, then the mixture is poured over the film, and rocked to and fro for a short time, the intensifier is then returned to the cup, the negative held up to the light, and examined, and if not intense enough, the intensifier is again applied ; great care is requisite at this stage, as if the process be carried on too far, the negative will be too intense, and will either be spoilt, or take an abnormal time to print ; practice and observation will be the only guides to success, the grand rules for half-tone negatives are, collodion free from dust, the glass plate clean, the bath at its full strength, and in good working order, proper time allowed the plate in the sensitising bath, well drained, afterwards a good exposure, develope until all details are out, then wash thoroughly, intensify with judgment, wash well, fix, and again well wash, and then, but never till then, open the dark room door and examine your new negative by daylight.

In making the collodion, soak the cellodoin in the Ether for about 12 hours before adding the spirits of wine, be sure the Ether is at least .725 degrees specific gravity, and that the Methylated Spirit is clean and free from gum. After mixing the collodion and iodiser, shake up well, but do not shake up after decanting, always decant sufficient for next day's use, into the bottle used for pouring, over night, so that it gets a chance to settle, and for air bubbles to get out.

Keep collodion in as cool a place as possible, and in decanting it, be very careful to do it away from fire, or lighted gas or paraffin, especially where the flame is below the bottle, as ether vapour does not rise, but falls.

In hot weather and during long exposures, wet plates are very prone to have a peculiar stain upon them, called oyster shell markings, the remedies for which are careful draining before putting into slide, and covering the bottom of carrier with clean filtering paper, so that the silver solution on draining down is absorbed by the bibulous paper instead of going back up the plate by capillary attraction.

In hot weather the back of plate, when put into dark slide should be covered with a wet piece of red blotting paper, or orange calico, *but not white*; a wet cloth laid in the camera will also tend to keep the plate moist, these precautions however are not required unless the exposure is likely to exceed a quarter of an hour.

Stripping Collodion Films.

Negatives made by the wet collodion process, can easily be stripped from the glass support, and in such a condition are extremely handy, especially for printing on Collographic plates, or on zinc, or copper, as the film being flexible, contact is more easily secured.

When it is intended to strip the film, the glass plate must be polished, *not albumenised*, and after the negative is dried, strips of thick paper are pasted along the four sides of the negative, with starch, or a solution of gum tragacanth; the negative is then placed on a levelling stand and a sufficient quantity of the following warm solution of gelatine is formed upon the plate (which should be slightly warmed first) and spread all over by means of a glass rod.

Gelatine	...	...	...	...	2½ ounces.
Sugar	...	...	...	...	1½ ounces.
Water	...	...	...	...	20 ounces.

Soak the gelatine in water until soft, then melt by gentle heat, then strain through two or three thicknesses of fine muslin, and pour upon the plate, using three ounces for a plate 12 by 10, more or less, in proportion for different sizes. The plate must be allowed to stay upon the levelling stand until the gelatine has quite set, then put it on a rack to dry which must be done in a cold current of air, if heat be used the gelatine would melt.

When the gelatine is *quite dry*, pass the blade of a pen-knife, all round underneath the strips of thick paper, when the negative film may be lifted right away from the plate.

In this condition the negative may be stored away without risk of being broken, the only condition being, it must be kept away from damp.

Another plan of stripping, is to coat the dry negative with a thick solution of india-rubber in benzole, then allow to dry on a levelling stand, then coat with a thick plain collodion, to which as been added a few drops of Castor oil, and when the collodion film is quite dry, place the plate in a dish of clean water, strip off the film from the glass, then place the film between sheets of clean blotting paper to dry.



Half-tone Negatives for Collotype upon Dry Plates.

Negatives suitable for collotype printing may be made upon the ordinary dry plates of commerce, and if made in a proper manner are just as good as the best wet collodion negatives.

Any pet brand may be used, and any developer, except ferrous oxalate, as under no circumstances will ferrous oxalate give as good a negative as either pyrogallol or eikonogen; hydrokinone is too apt to give hard negatives, so is not

recommended unless the operator has had practice in its use.

Whether pyrogallic or eikonogen be used for the development of the negatives, ammonia should not be used as the alkali, being too volatile and therefore too uncertain in its results, the carbonate of Soda, or of Potash being far better, both as regards certainty of result as well as quality of negative.

As a preservative for either pyrogallic or eikonogen the meta bisulphite of potash is far ahead of sulphite of soda, and should always be used.

The annexed formula may be always relied upon, and should be used in preference to any other for good half-tone negatives.

STOCK PYROGALLOL.

Meta-bisulphite of Potash	...	...	1 ounce
Water	...	...	9 ounces
Dissolve, then add			
Pyrogallic acid	...	...	1 ounce

STOCK CARBONATE.

Saturated solution of common washing soda.

DEVELOPER A.

Stock pyrogallol	...	...	2 ounces
Water	...	...	18 ounces

DEVELOPER B.

Saturated solution washing soda	...	2 ounces
Water	...	15 ounces

For a normal exposure use equal parts of A and B, but the best plan is always to begin with two parts of A to one of B, adding more of B if the image is slow in making its appearance.

Negatives for collotype must have detail in lights and in shadows, and be quite free from fog or veil, thick yellow and over-exposed negatives being quite unsuitable.

Wash the negative well after fixing, then clear by immersing in a solution of

Alum	...	...	...	...	1 ounce
Water	...	...	...	...	20 ounces
Nitric Acid	...	...	...	...	$\frac{1}{2}$ dram
or Citric Acid	...	..	...	...	1 dram

From two to five minutes will be a sufficient time for the full effect of this bath, then wash well and dry the negative on a rack.

If the negatives are made in the studio the reversing mirror may be used and a reverse negative made at once, but if the negatives are landscapes, houses, etc., then to fit them for collotype they must be stripped from their original support and remounted with the film turned round upon another glass plate, or a sheet of celluloid.

The operation of stripping is quite practicable and safe, if the directions given below are rigidly followed out, but if at all modified the operator has only himself to blame if failure results.

First of all the negative must be quite dry, and the back and edges of plate quite free from dirt and from remnants of gelatine; if not, trouble will arise afterwards, by the gelatine &c., getting between the film and glass during the stripping operations.

Before stripping the negatives clean a few sheets of patent plate glass at least one size larger than the negative to be mounted upon it. For instance, if the negatives are $8\frac{1}{2}$ by $6\frac{1}{2}$ the patent plates must be 10 by 8 or 9 by 7.

Celluloid may be used instead of glass and its use is strongly recommended, as it is just as easily manipulated, and is free from all risk of breakage in the printing frame, as well as

less trouble to store, and for price is cheaper than patent plate, celluloid being sold in sheets 50 by 20 inches at four shillings per sheet.

Whether glass or celluloid be used the manipulations are the same, they must first be well scrubbed with a rag dipped in fine whiting moistened with a little ammonia, well washed under the tap, then again rubbed with a rag dipped in a dilute acid, and again well washed, then coated with the following solution—

Gelatine	...	...	...	...	1 ounce
Water...	...	...	...	...	20 ounces

Soak the gelatine till soft, then melt in a jar placed in a pan of water over a gas stove ; when the gelatine is dissolved add 10 drops of a saturated solution of chrome alum, mix, then filter through filtering paper.

Flow this over the glass or celluloid plate, and then put the plate on a rack to dry ; a quantity of these may be prepared at once and stored away in a dry place, as they improve by keeping.

The next operation will be to carefully level a large sheet of plate glass upon which the negatives to be stripped are laid, and then covered with as much collodion as they will hold without spilling ; be sure that the collodion goes to the edges, and that as much is put on as possible so as to get a good thick film of collodion ; if this film of collodion is too thin the negative films curl up and are difficult to handle, but when thick lie flat and are easily manipulated.

Collodion for this purpose can be purchased at the chemists under the name of flexible collodion, or to order from Mawson and Swan ; but it is easily made by dissolving

Gun Cotton	...	...	...	...	1 ounce
Methylated Ether	...	...	...	...	15 ounces
Methylated Alcohol	...	...	...	...	15 ounces

If used directly after solution, filter through cotton wool, but if allowed a month to settle it can be decanted quite clear.

The thick film of collodion must be allowed to set thoroughly right through, but must not get dry. When set the negatives are immersed in clean cold water which must be frequently changed until the ether and alcohol are quite removed from the film, and the water flows evenly over, instead of having a greasy appearance.

The negatives are now immersed one at a time in a dish containing

Hydrofluoric Acid	...	...	...	2 drams
Water	...	...	...	20 ounces

To remain until the film commences to lift at the corners, when this is the case the negative is removed and well washed under the tap, after which it is put into a large dish of clean water and the film carefully lifted off the original support, which is put upon one side; turn the film over and slide under it a sheet of patent plate or of celluloid coated with gelatine, the gelatinised side next the collodionised side of film, carefully adjust the negative film in its position upon the gelatinized plate, then lift the two from the water, in such a manner as to expel all air bubbles from between the negative film and the glass plate; drain as much water as possible, then lay on the bench and place over the film a piece of stout tracing cloth, then squeegee gently; remove the tracing cloth, and put the plate on a rack to drain, when drained surface dry, immerse in a dish containing clean methylated spirits of wine for ten minutes, remove and put on a rack to dry.

This bath of methylated spirit must not be omitted, else, if the collodion is extra horny the film will be liable to split off in drying, but when the spirit is used there is no risk of such a contretemps.

Half-tone negatives for collotype that are too large or too small, for the collotype print required, must be reproduced ; when the collotype print is to be much reduced in size, a very good plan is to make a single transfer carbon print from the original negative, and from this print make the small negative, without using the mirror, then a reversed negative will be obtained, but for negatives the same size, or enlarged, this method does not give the best results.

To reproduce a negative the first step is to make a transparency and to get the best result this transparency must be made in carbon upon the special tissue sold for the purpose. Very beautiful transparencies can be made upon dry plates, but no matter how made, or with what care, for the purpose at present under discussion, no dry plate transparency will give as good a reproduced negative, as can be made from a carbon transparency, this is not merely an opinion, but a hard fact arrived at after careful trial and experiment.

Carbon transparencies are easily made and require no costly, or special apparatus, and as the tissue upon which they are made can be bought ready sensitised, the trouble is reduced to a minimum ; ordinary carbon tissue as used for paper prints must not be used but the special transparency tissue, made specially for transparency work.

In printing upon carbon tissue it is necessary to have the outside margin of print protected from light, during the time of exposure under the negative, therefore if the whole of subject (say on a half-plate) be required, the tissue must be cut at least 7 by 5½ thus giving a quarter of an inch margin all round, which margin must be protected from light by a mask outside the negative, when only a portion of the subject on negative is required a mask with an opening a little larger

than the subject may be used behind the negative or upon the film.

The exposure to light of carbon transparency tissue is not very rapid and may be approximately put at from three to five times that necessary for an ordinary silver print, the exposure must be ample, as it is very necessary to have the full amount of detail present in the negative, so it is best to err on the side of plenty, rather than not enough.

The tissue after exposure is mounted for development upon glass plates, coated with

Gelatine	...	...	...	...	1 ounce
Water	...	...	...	...	20 ounces
Bichromate of Potash	...	...	...	...	30 grains

dissolved by heat and filtered before use.

The glass plates must be a little larger than the tissue. For a half-plate transparency whole plate glass must be used, cleaned with a rag dipped in weak acid, then well washed under the tap and the above solution flowed over, then put on a rack to dry; when dry expose the plates to daylight for a short time to render the film of gelatine quite insoluble.

The exposed tissue is put into a dish of clean cold water until limp, then mounted face down upon one of these gelatinised plates and squeegeed well down, so as to expel all water and air from between the two surfaces. Mount all the prints in the batch in this way, then immerse in warm water at 80 degrees F., and as soon as the paper backing is loosened by the warm water dissolving the gelatine, strip it off and throw it away. Add more water a little warmer and let it remain from ten to twenty minutes, then raise up one end of plate and gently lave with the warm water until the whole of the soluble gelatine is removed and the picture left on the glass clear and sharp; rinse under tap and put on a rack to dry.

A good transparency will be full of detail in lights and shadow and free from defects, and such only must be passed as suitable for the next stage.

Sensitised carbon tissue will not keep longer than a month, therefore must be used as soon after receipt from the makers as possible. In case of over exposure hotter water may be used to finish the development with.

Negatives the size required are made from these transparencies in the enlarging camera by transmitted light, using a lens at least a size larger than the transparency, without any reference to the size the enlarged negative has to be.

The Reversing Mirror.

The mirror is a piece of perfectly plane glass, coated on the surface with a thick film of pure silver, highly polished. This silvered glass must be mounted in a mahogany box, and fitted on the front of the camera, the lens being fitted in front of the mirror, see page 4. This mirror is placed in grooves at an angle of 45 degrees from axis of lens, and so situated, receives the image projected by the lens, reflecting it on the focussing screen, or sensitive plate in camera, by which means a negative is obtained, which, when looked through, with the film between the operator and the glass, the image is in its proper position, whereas, if the lens be used without the intervention of the mirror, it will be necessary to have the glass between the eyes and the film, to get the image in its proper position, and as the generality of photographic negatives are taken, without the intervention of the mirror, they are called ordinary negatives in contradistinction to those made through the mirror, which are called "reversed" negatives.

The three adjusting screws in block on page 4 are best dispensed with, and the box made quite true at first.

The silver surface of the mirror requires great care and attention to preserve its lustre from tarnish, which would make the exposure in the camera longer, besides which, the cost of re-silvering is too great to allow of the surface being spoilt too frequently through carelessness,

At the end of each day's work, remove the mirror from the box and warm it in front of the fire (not over the gas flame) just slightly, then wrap it carefully in a piece of fine velvet, which has also been previously warmed, then wrap up in a piece of india rubber or macintosh cloth, and put away in an air tight box; by doing this, the mirror, if well silvered at first, will last for a year or two.

If the surface should get tarnished, get a square of very fine chamois leather, and place in the centre a pellet of cotton wool, then gather up the leather, and tie the wool in the centre, making a small globe about an inch-and-a-half in diameter, now warm the mirror, and after dipping the leather globe into fine rouge, proceed to polish gently with a quick circular motion, using little or no pressure,—take care in doing this that the mirror, the leather, and the rouge are quite dry, else the silver coat will come away—*verb sap*.

In purchasing a mirror be sure and get it large enough to take the cone of rays from the lens it has to be used with; for a lens three inches in diameter, the plane mirror should measure about $6\frac{1}{2}$ inches by $3\frac{1}{2}$ inches.

The box to hold this mirror should be made square at the bottom, fitting into the rabbet of the camera front, so that when objects are to be photographed that will do better laying on the ground than when fixed against the wall, the mirror can be placed to look down upon the object.

For silvering the glass, one cannot do better than to quote the directions for working Common's process given by Major Waterhouse in a previous volume of the PHOTOGRAPHIC NEWS.

"The solutions recommended by Mr. Common are three—

(1) Nitrate of silver ...	...	...	...	1 ounce
Distilled water ...	...	...	...	10 ounces
(2) Caustic potash ...	...	...	...	1 ounce
Distilled water ...	...	...	...	10 ounces
(3) Glucose ...	...	...	...	$\frac{1}{2}$ ounce
Distilled water ...	...	...	...	10 ounces

The above quantities are sufficient for 250 square inches ; consequently an ordinary copying mirror 8 by 6 would require rather more than 2 ounces of each solution, and other sizes in proportion.

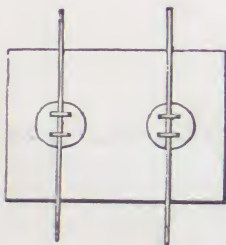
The caustic potash and distilled water must be quite pure. Ordinary caustic potash will not answer at all. The best to use is known as *pure by alcohol*.

The glass surface to be silvered is carefully cleaned with strong nitric acid, applied, as recommended by Mr. Browning, with a buckle's brush, then well washed in clean water, and after rinsing with distilled water, laid, face downwards, in a dish of distilled water till wanted.

Before cleaning the glass, it will be necessary to arrange for supporting it face downwards in the depositing dish, so that the surface to be silvered may be quite horizontal, and just below the level of the fluid, which should be about half an inch above the bottom of the dish.

I have generally used a large cork, about four inches in diameter, cemented to the back of the plate, and fitted with three strings, by which it could be suspended in a level

position and adjust to any height by winding the string over a roller placed at a convenient height above the dish. As this arrangement was not available, I fix on the back of the plate two ordinary wide-mouthed bottle corks of equal thickness, in the positions shewn in the figure, and to these corks attached thin slips of bamboo running transversely across the plate, and of sufficient length to rest on the sides of the dish, thus:—



The slips of bamboo gave the arrangement a certain amount of spring, by which the height of the plate could easily be regulated, by putting on weights till the surface of the plate, was just below the level of the fluid in the dish.

To prepare the silvering solution :—A sufficient quantity of the silver solution No. 1 (2 ounces) is put into a perfectly clean glass. Ammonia is dropped in till the precipitate first formed is just re-dissolved. The same quantity of potash solution, No. 2, as of silver is now mixed in, and the precipitate again dissolved by ammonia. A little more silver solution is then added to produce a distinct turbidity, and distilled water to make up the quantity necessary to fill the depositing-dish to about three-eighths or half an inch, and the mixture is then filtered through cotton into another clean glass vessel.

The same quantity (two ounces) of filtered solution of glucose, No. 3, as was taken of silver and potash, is now mixed in, and the whole poured into a depositing-dish (which should preferably be of glass, well cleaned with nitric acid).

The glass plate is then taken out of the distilled water and laid face downwards on the silvering solution, being supported as before described, just above the surface, so that the solution does not cover its back.

Mr. Common places the requisite quantity of distilled water in the dish in which the mirror has been remaining face downwards, and then, having lifted the mirror up, pours in the undiluted silvering solution, together with the glucose solution, stirs well together, and then carefully lowers the mirror again into the dish.

Almost immediately after the immersion of the plate, the silvering action begins, and, if things are going on well, a brilliant reflecting surface will be seen at the back of the plate and in forty minutes, or even less, a good deposit of silver will be obtained. It is usually recommended to stop the action as soon as the silvering fluid appears clear and free from turbidity; but it is not always easy, I find, to see this.

After silvering, the plate is thoroughly well washed, finishing with distilled water, and dried off quickly. A slight cloudiness of the surface may appear, and must be removed by polishing before the mirror can be used. It is better to allow the mirror to remain a day or so before polishing, in order to harden the coating.

To polish the plate, it should be slightly warmed, and perfectly dry, when rubbed very gently in small circles with a piece of very soft and dry chamois leather, afterwards using a little jewellers' rouge.

Mirrors should always be kept in a dry place, and will require repolishing from time to time.

Preparation and Care of Rollers.

Leather rollers when new should first of all be warmed in front of a good brisk fire, and when warm rubbed with a piece of Russian tallow until the leather will not absorb any more, then allow the roller to stand twelve hours and repeat the operation, then take some middle varnish, smear some of it along the roller, and on a clean slab, roll vigorously, and repeat the operation two or three times, scrape the roller with the grain, then roll up in varnish, allow to stand all night, scrape again, roll up again next day, scrape, then roll up with collotype ink, scrape and roll up, repeating this until the roller takes the ink evenly.

In scraping the roller it must always be scraped one way. and that with the grain, which way the grain lies being ascertained before greasing, and a mark made upon the handle of roller, so that no mistake can be made afterwards.

Glue rollers should always be hung up in a cold, dry room, and, if not wanted for some time, should be covered with vaseline and wrapped up with tracing paper.

After each time of using, scrape the roller before putting away, and if, after using, the roller is likely to be some time before being wanted again, after scraping smear with Russian tallow, and wrap up in paper, scraping before rolling up in the ink again.

The Ruled Sheet.

IN the production of half-tone zinc blocks, the screen negative plays a very important part, and if it is not of the best quality and of a suitable grain, a fine printing block cannot be obtained. The foundation of these screens is a print from a steel or copper plate, (steel by preference as it is harder than copper, gives a sharper line, and lasts so

much longer-ruled by a special machine with fine lines in proportion of from 100 to 150 lines to the inch. The plate should be at least eighteen inches square, larger when possible, but certainly not smaller, as to get screens of the very finest quality a reduction of at least four times is requisite. These plates properly ruled and without flaw, are very difficult to obtain, I have had no less than six plates at different times from different makers, each of whom at the time of enquiry, were quite confident of their ability to turn out the required article, but each plate when sent in was quite useless,

The cause of this difficulty is not far to seek, each firm relying upon the ease with which they were able to rule the short tints in their every-day work upon wood blocks, forgetting to allow for two things, *viz.*, first the partial wear of the bar carrying the cutter, secondly for the same partial wear of the index screw ; by the first fault the lines cannot be ruled straight, or parallel, the second causes unequal distances, giving a screen that looks more like a tolerably good piece of gauze than a ruled plate.

With the form of machine now in use, even if quite new, the production of a properly ruled plate is attended with so many difficulties, and chances of failure, as to preclude many from undertaking half-tone blocks, but I am glad to say that just as the last sheets of this book were passing through the press, my attention has been called by Mr. A. Calvert, of 69, Sackville St., Manchester, to an entirely new machine he has invented and had manufactured for the purpose of ruling these plates, this machine is entirely automatic, will rule a plate 36 inches by 24 to the 500th. part of an inch, from beginning to end without any attention.

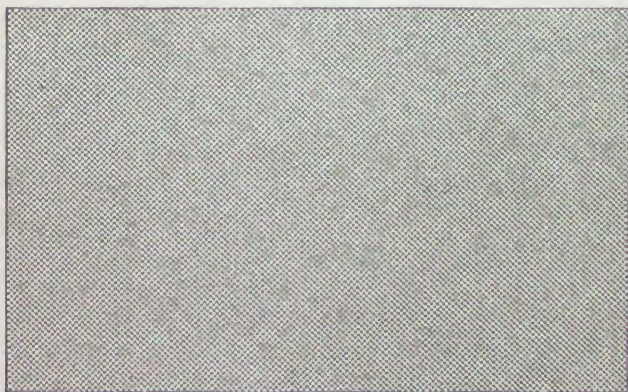
Mr. Calvert has courteously allowed me to print the small specimen plate sent me which is ruled rather coarsely so as to be certain to meet the exigences of a flat tint or an ordinary printing machine, but it is sufficiently fine to give a good idea of what is really required.

The block is the reverse of an ordinary ruled sheet, being printed from in the ordinary type press, and in this condition shows how a screen negative must be *viz.*, with clear lines, and grey whites.

When once the ruled plate is obtained, all trouble is not quite at an end, as the printing of proofs from the plate is a very difficult operation and can only be done by an expert copper-plate printer, and unfortunately just at present that is a class of workmen very difficult to obtain. The proofs must be made upon good white paper with jet black or sepia ink, and each proof must be quite perfect.

The plate should be square, and the lines ruled one way only, the crossing being done by means of a double exposure, and instead of having both sets of lines the same thickness, one set may be coarser than the other, by moving the camera, and re-focussing between the two exposures; to obtain the crossed lines, the sensitive plate may be turned round in the dark slide, or the sheet itself turned upside down.

The screen negatives must be thin, with the lines clear glass so that the detail in the original can get through the film, if at all dense nothing but harsh results can be obtained.



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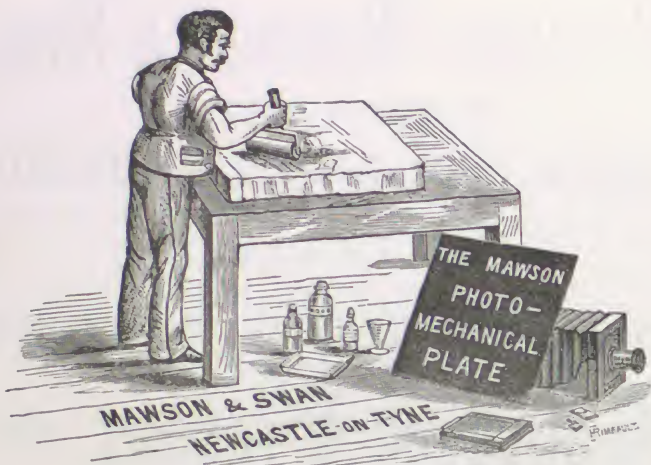
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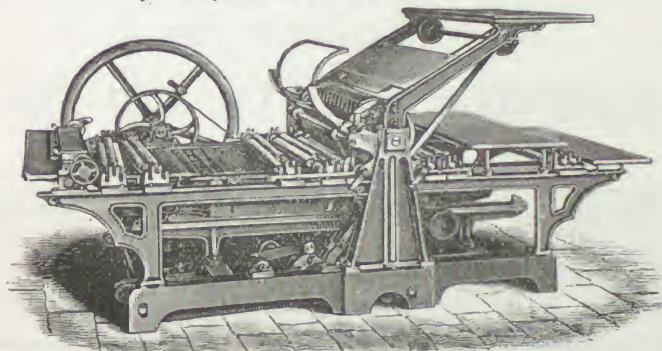
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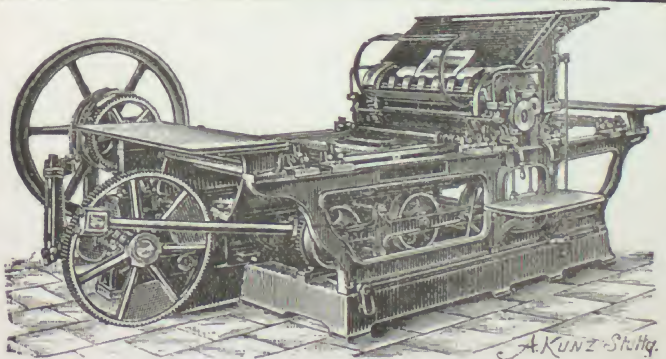
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